GAS WAYS ARE

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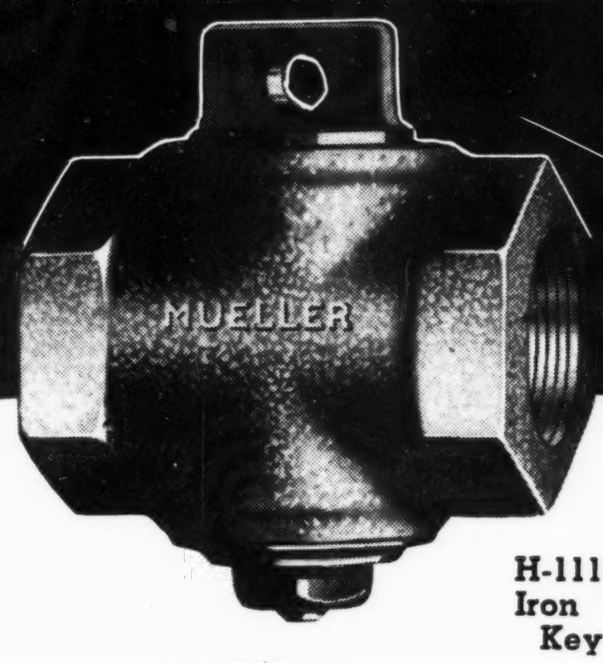
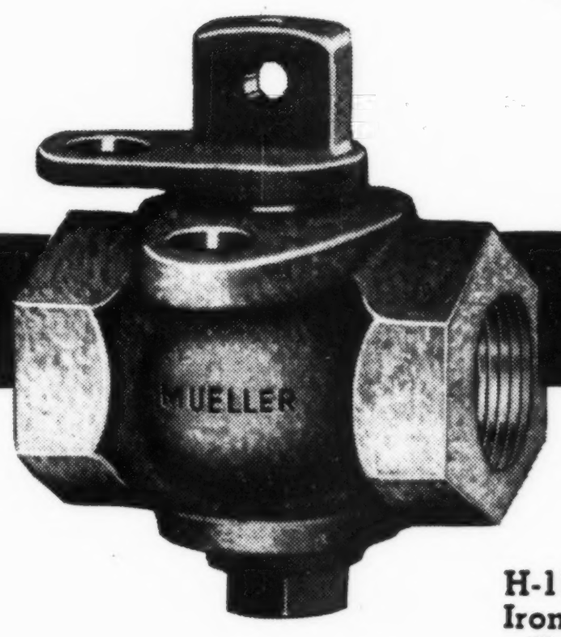
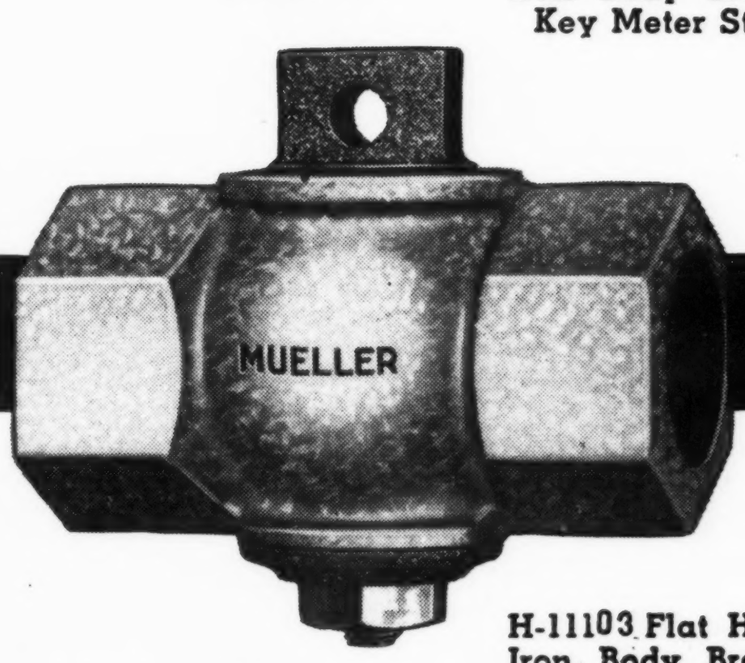
MUELLER STRAIGHTWAY STOPS



H-11100 Flat Head Iron Body Bronze Key Gas Stop



H-11102 Lock Wing Iron Body Bronze Key Meter Stop



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Dresser Manufacturing Division	8, 9, 19
Empire Stove Co.	83
Fisher Governor Co.	65
Fluor Corp., Ltd.	4, 5
Gas Appliance Manufacturers Assn.	—
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Gasair Associates	—
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Hydrauger Corp., Ltd.	—
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Kitson Division, The Welsbach Corp.	94
Longhorn Industries	88
Maloney Co., F. H.	16
Milwaukee Gas Specialty Co.	—
Minneapolis-Honeywell Regulator Co.	79
Motorola, Inc.	—
Mueller Co.	1
National Tube Co.	11
Natural Gas Equipment, Inc.	—
Natural Gas Odorizing Co.	96
Nordstrom Valve Co.	12, 13
Norton-McMurray Manufacturing Co.	86
Oil Well Supply Co.	3
Oronite Chemical Co.	14
Pacific Gas Corp.	—
Payne Furnace Co.	77
Peerless Manufacturing Co.	91
Phillips Petroleum Co.	—
Pittsburgh Equitable Meter Division Rockwell Manufacturing Co.	Front Cover
Porter Co., Inc., H. K.	28
Reliance Regulator Division	Second Cover
Reynolds Gas Regulator Co.	95
Roberts-Gordon Appliance Corp.	—
Robertshaw-Fulton Controls Co.	—
Roots-Connersville Blower Corp.	89
Roper Corp., Geo. D.	—
Security Valve Co.	92
Semet-Solvay Co.	—
Servel, Inc.	66
Sharples Chemicals Inc.	32
Skinner Co., M. B.	10
Smith Corp., A. O.	71, 73
Sprague Meter Co.	—
Stacey Brothers Gas Construction Co.	—
Standard Pipeprotection, Inc.	87
Titan Valve & Manufacturing Co.	—
U. S. Pipe & Foundry Co.	—
United Petroleum Gas Co.	96
United States Steel	3, 11
Utilities Conversion Co.	—
Vulcan Proofing Co.	15
Walworth Co.	22
Ward Heater Co.	74
Warren Petroleum Corp.	93
W-K-M Co., Inc.	17

GAS

REG. U. S. PATENT OFFICE

Twenty-Fifth Year of Publication

March, 1949 ECA NBP ASSOCIATION **Vol. 25—No. 3**

COMMENT

Highlights 21
Thermally Thinking, *by Edward Titus* 23
Technical Trends, *by Guy Corfield* 27
Promotional Notes and Notions, *by Stanley Jenks* 29

ARTICLES

New Station Boosts Capacity of Biggest Inch to 305 MMcf *by J. A. Millen and H. C. Vander Heyden* 33
Versatile Chicago Coke Oven Battery Near Completion, *by William Helme* 37
Plant Operation in Relation to Utilization, *by Warren E. Churchill* 38
Elements of Static Electricity, *by Sidney K. Gally* 42
Kokomo's Dual Standby Facilities Assure Good Winter Peak Service, *by J. R. Strother* 47
Gas-fired Infrared Panels Dry Railroad Cars 48
Natural Frequencies of Compressor and Engine Manifolds, *by Dr. Eugene F. Murphy* 50
How Gas Keeps the Phones Ringing 55
The Everett Trencher 57
Are Our Employee Relations Tools Really Effective? *by Orie Van Rye* 59
The Fable of the Diplodocus, *by Robert O. Caulkins* 61

DEPARTMENTS

Operating Ideas	58	Sales Slants	84
Associations	63	Current Reading	87
Calendar	67	Home Service	89
News	70	People	91
New Products	81	Catalogs	94

PUBLICATION OFFICE

198 SOUTH ALVARADO STREET, LOS ANGELES 4, CALIFORNIA • Phone: DREXEL 4337

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CHICAGO, DAVID CARMEN, Manager, 1064 Peoples Gas Building, WABash 2589
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Highlights

NATIONALIZATION OF BRITISH GAS INDUSTRY DUE SOON. Enactment of the bill passed last year by Parliament will take place May 1, according to Hugh Gaitskell, fuel and power minister.

OIL PRICE DIP REFLECTED IN GAS RATES. A reversal in the trend of increasing make-up oil costs enabled Portland Gas & Coke Co. to announce rate reductions last month. Brooklyn Union's dizzy rate merry-go-round was at least braked by substantial cost reductions. Esso-Standard led the pack in a fourth-round price slash with a 20-cent cut in Bunker C postings.

THROUGH 2200 MILES OF PIPE, 600 MMCF. FPC has revealed that from the period July 1 to Dec. 31, 1948, it authorized construction of such facilities. Total estimated cost, $191,382,265, of which $140 million was for major projects. Thirty-two cities of more than 50,000 population in 12 states and D.C. will benefit. This six-month period ranked third in both number of certificates granted and estimated costs of projects of the eight similar periods since Feb. 7, 1942. The previous six month's half-billion still is tops.

TEXAS-SAN FRANCISCO LINE SQUEAKS THROUGH. One day before El Paso Natural Gas Co.'s option on certain reserves would have expired, the FPC okayed both El Paso's and Pacific Gas & Electric Co.'s plans for a line to bring gas to the Bay area. Not approved was the application of San Juan Pipe Line Co., which was severed from the other dockets because of a jurisdictional dispute.

EAST YIELDS "BIGGEST" TITLE TO WEST. Pacific Lighting Corp., California holding and operating company, has replaced Consolidated Edison, New York, as largest gas system in the United States. A difference of 12,000 meters separates the two, both being well over the 1.3 million mark.

FPC WANTS TO SETTLE GEORGIA-FLORIDA LINE APPLICATIONS. The commission has set May 16 as hearing date in proceedings on Southern Natural Gas Co. and Atlantic Gulf Gas Co.'s pleas for lines to carry gas to the southern portion of the Atlantic seaboard. The two dockets will have become two years old in March and April, respectively. Neither company has filed requested data since, says FPC, which wants to clear its calendar.

INDIANAPOLIS SEEKS NATURAL GAS. Citizens Gas & Coke Utility wants the FPC to direct either Panhandle Eastern Pipe Line Co. or Texas Eastern Transmission Corp. to tie in with its system. The application, filed last July, also seeks daily delivery of 10 MMcf from Texas Eastern, Texas Gas Transmission, or Tennessee Gas. Hearing is calendared for March 7, with limited intervention by Manufacturers Light & Heat, Ohio Fuel Gas Co., and United Fuel Gas.

NEGA EXPECTS RECORD ATTENDANCE AT ANNUAL MEETING THIS MONTH. New England gasmen will meet at the Statler, Boston, March 24-25. Natural gas as related to New England, fuel reserves and trends, new production processes, and sales, merchandising, and advertising topics head the agenda.

NEW FPC RULES. Three new amendments to its "general rules and regulations" have been promulgated. The first defines the term "facilities" so as to make it possible for natural gas companies to construct "certain types of minor changes in existing systems" without having to seek certification. Replacements, metering and regulating stations, auxiliary facilities are included. The second limits issuance of temporary certificates; the third exempts from certification requirements temporary construction and operation where necessary to assure adequacy of supplies.

RAPID INCREASE IN GAS SALES PREDICTED. The National Security Resources Board thinks gas sales in 1952 will be 55% higher than in 1947, 81% above 1945. Fuels price imbalance will contribute heavily, the board said in a recent statement. Expansion projects under way or proposed, which may be completed by 1952, will cost over $3 billion.

RESERVES GOOD FOR 35 MORE YEARS. So said G. G. Oberfell, vice president in charge of research and development, Phillips Petroleum Co., in a talk in Washington last month.

EAST OHIO WINS FREEDOM FROM FPC JURISDICTION. The U. S. Court of Appeals for the District of Columbia last month declared the company was not an interstate carrier of gas, since its connections at the state boundary with Hope Natural and Panhandle Eastern were for the purpose of taking gas for intrastate distribution. The decision reversed a recent FPC ruling which declared jurisdiction over the company's operation of 650 miles of line.

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DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

THERMALLY THINKING

By EDWARD TITUS

the fpc analysis

IT'S A PARADOXICAL SITUATION when one government department tells an industry it ought to get more venture capital into its financial structure, and other government departments make it almost impossible to do so. Yet that appears to be the case today in the gas industry.

Management is doing plenty of thinking on the raising of the more than $2 billion needed for gas industry expansion. Naturally management would like it best if the necessary funds could be raised in an economically sound manner that would bode well for the country through thick times and thin.

It is intended here to take up the current debate as to whether the gas industry, along with other industry, is rolling in profits so fast that any claim that it is difficult to secure venture capital is ridiculous.

The argument started when Chairman Hanrahan of the Securities and Exchange Commission in a widely publicized speech called attention to alleged dangers of too heavy debt financing in this industry.

There were various interchanges, and it wound up with the Federal Power Commission issuing a study during the winter, the conclusion of which was that:

> It is clear that the rates of return fixed by the Federal Power Commission have not deterred investors from purchasing equity securities of natural gas companies, thereby forcing such companies to finance their expansion programs through issuance of debt securities.

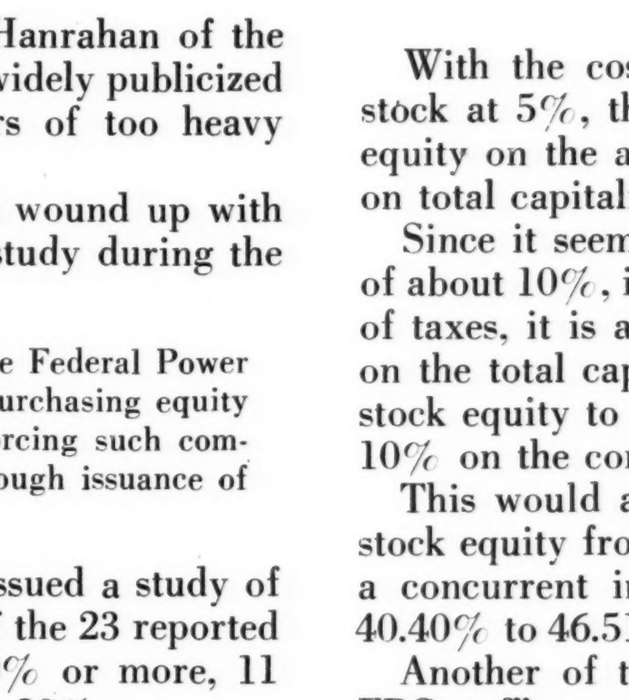
In support of this conclusion, the FPC issued a study of 23 companies purporting to show that 19 of the 23 reported earnings on equity capital for 1947 of 10% or more, 11 of them ranging from 15%, and three above 20%.

It's the purpose here to analyze the implications of these statements, since apparently the FPC analysis to date to a large extent has gone unchallenged.

First of all, it's an undebatable fact today that industry in general is encountering difficulty in raising venture capital. The market for equity securities is small, so there must be some reason for it.

A pertinent observation about the FPC study is that it covered a very favorable year. Analysis of some of the fallacies said to exist in the commission figuring is a bit complicated, but here goes:

The FPC report stated that the weighted average earnings-price ratios of nine natural gas companies having common stock in the hands of the public were 9.9%, based on Dec. 2, 1948, market quotations. By using a hypothetical capital structure of 50% debt at 3½% interest, 25% preferred stock at 5% dividend, and 25% common stock equity, the report concluded that the common stock would earn 12% or more on its book equity under a 6% rate of return.



It appears the FPC staff made an error in using a hypothetical capital structure instead of one representing actual conditions, to establish the validity of a 6% rate of return.

By means of calculations from the FPC publication "Statistics of Natural Gas Companies—1947," it appears that the approximate average capitalization ratios during the years 1943 to 1946 inclusive were:

Common stock equity	48%
Preferred stock	11
Debt	41
	100%

With the cost of debt capital at 3½% and preferred stock at 5%, the common stock would earn 8.37% on its equity on the above basis, where an overall return of 6% on total capitalization is allowed.

Since it seems common stock investors require a return of about 10%, in view of the risks they take and the inroads of taxes, it is apparent that an overall return of only 6% on the total capitalization forces a thinning of the capital stock equity to a point where the required return of about 10% on the common can be realized.

This would appear to account for the drop in common stock equity from 48.17% in 1943 to 44.44% in 1947, and a concurrent increase in the composite debt ratio from 40.40% to 46.51%.

Another of the fallacies which appears to exist in the FPC staff's use of a hypothetical capital structure to justify a 6% return is this:

On the basis of the staff's own statement, a company limited to that return would never be able to improve its capital structure substantially. In other words, it could never substantially increase the ratio of common stock equity because then it would not have adequate earnings for the common stock. This appears to perpetuate a situation that is contrary to sound principles of regulation and finance.

Another apparent fallacy arises from the fact that the FPC in its report does not disclose the rate of earnings on the business subject to its rate jurisdiction. The data relied upon include both regulated and non-regulated business.

The FPC is not entitled to take credit for a healthy financial condition resulting from profits from non-regulated sales. The profits from the non-regulated end are substantial, considering such companies as El Paso Natural, Colorado Interstate, Mississippi River Fuel, and United Gas Pipe Line.

The inference that the rates of earnings for 1947 on the common equity are the earnings allowed under FPC regulation would seem to be in error in still another respect. The wholesale rates of several companies listed are now being investigated. These include Panhandle Eastern, Colorado Interstate, Canadian River, United Gas Pipe Line, and United Natural. The investor considering the purchase of equity securities has to be governed by the threat of the future effects of regulatory policy, and cannot afford to rely on a favorable income report of one year.

There would appear to be still another error in the inference that the FPC generally allows a rate base equal to the equity of all the securities outstanding. Usually substantial amounts of cash, construction in progress and other assets are given a non-utility status and omitted from the rate base. The rate base on which the 6% is allowed is ordinarily less than the capitalization of the utility. For instance, Panhandle's total capitalization on Dec. 31, 1947 was $112,253,000, and the FPC staff's proposed rate base is only $102,624,000.

It is significant that one of the newest enterprises, Trans-Continental Gas Pipe Line Co., was financed with a common stock equity of only 12% of total capitalization. The balance was represented by debt.

It is obvious that the effect of present regulatory policies is to discourage the risk of venture capital in this and many other industries. With more security from unreasonable federal regulation, more venture capital would be available.

In addition to the discouragements to venture capital peculiar to the gas industry, there are other dampers to the carrying out of Chairman Hahrahan's hope of more equity financing that have their effect on all industry.

The difficulty of raising money through sale of stock is evidenced by the fact that according to figures of the SEC and the Department of Commerce, industry last year spent almost $19 billion on new plant and equipment and was able to get only a little over a billion of it by selling new stock issues.

The extent to which taxes play a part as a deterrent to venture capital is evidenced by the statement that under double taxation of dividends, the government takes between 50 and 80 cents out of each dollar of profits, depending on the income bracket of the recipient.

Moreover, the stockholder got 76% of all corporate profits in 1939, against only 38% in 1947.

The above are a few of the factors menacing the investor who takes a chance with his money today. And the general lack of respectability of making a profit (according to some present-day social theory), is what slows the putting up of venture capital in the hope of making a profit.

the brighter side

WHILE THE ABOVE might appear a rather dark picture for venture capital as of the present moment, there are some more constructive angles.

A few weeks ago, Gov. Roy J. Turner of Oklahoma visited President Truman and came away with a statement as quoted in the press that the President had indicated he would have a study made of putting gas production under state controls.

It seems Governor Turner also discussed with the President the bill of Representative Lyle, a Democrat from Texas, and that the President indicated he probably would have a study made of it.

The Lyle bill has provisions similar to the bill of Sen. Clyde M. Reed, Republican, of Kansas, introduced at the last session of Congress. It would be about like the commission's own present rule that exempts from the status of natural gas companies subject to federal regulation the producers not affiliated with interstate pipeline companies.

Such a bill, if passed, should boost the morale of the industry. It would mean that independent producers would not be depending on a rule of the commission which might be changed overnight by the commission itself, but on a law which could be changed only by Congress.

Neither the Lyle bill nor a similar bill by Representative Harris of Arkansas would cure overnight all the evils that have grown out of some phases of regulation. Either, however, would be a step in the right direction.

If one of the above bills is passed, it will still remain separately to straighten out the status of the fields owned by affiliates of pipeline companies.

Of equal importance with legislation is the outcome before the Supreme Court of the United States of the effort of the FPC to secure an injunction to restrain Panhandle Eastern Pipe Line Co. from going forward with its plan to transfer natural gas acreage to the newly formed Hugoton Production Co.

The final argument will be a momentous occasion.

a fancy program

IT'S BEEN A PLEASURE to look over the All-Electric Kitchen Promotional Program, supplied through the courtesy of the Edison Electric Institute. It's all very fancy, and the freshly printed paper smells good.

Spearhead of the program is the Kitchen-izer's Digest, longer and wider but not quite as thick as the Reader's Digest, and including articles entitled "This Is How I Keep House," "Scheme for a Dream," "Revision with Vision," "A Farm Kitchen Full of New Ideas," "Nine Essentials of a Good Kitchen," "Kitchens Needn't Look Clinical," "This Kitchen Makes Every Job Easy," "How to Plan Your All-Electric Kitchen," and "The Private Life of Your Kitchen."

It's all pretty attractive—on paper.

The gas industry knows the answers to all this fine talk, in the greater economy, sensibility, and well-tried practicability of gas appliances—plus the fact the electric case is sometimes based on an erroneous comparison of the most modern electric equipment with outmoded gas appliances, instead of a fairer comparison of the best kinds of both. And the gas industry had better use these arguments fast and well, because there's no limit to the ambitions of these electric fellows.

However flossy the electric kitchen may be, the best brains of the electric industry were stumped at the Hotel Statler in New York the other day, as evidenced by the following news story in the *New York Times:*

> ELECTRICAL WIZARDS VANISH IN DARK AS WIRING FAILS AT ANNUAL MEETING
> 200 of Nation's Top Experts Halt Their Talks on Electronics, Microwave, Nuclear Spin, While Hotel Fixes Worn-out Cable

Meanwhile the fallibility of things electric was further indicated when that shrewd publication, "*Barron's*, the National Business and Financial Weekly" taking up the current sales battle between the electric and gas industries, and discussing what kind of equipment the individual was going to buy, had this punch line:

"Furthermore, severe winter storms which break power lines and stop service may weigh heavily in the decision."

TECHNICAL TRENDS

by Guy Corfield

Synthetic Earthquakes

ONE OF THE METHODS that has been in use for many years in petroleum exploration is to create miniature earthquakes by setting off explosives in holes drilled in the earth or under water in lakes or tidelands. Observations, by siesmographic methods, of the travel and reflection of the resulting earth waves are used to determine the probable presence or absence of underground oil and the accompanying natural gas. Such exploration is relatively expensive because of the cost of drilling the holes; may be dangerous or destructive to surface structures because of localized earth movement; kills marine life when conducted under water; is inefficient in energy application; in general, is somewhat cumbersome and time consuming.

A modification of this method, which removes many of these disadvantages, has recently been announced. It was developed by Thomas C. Poulter of Stanford Research Institute of California, who made the initial experiments in the Antarctic with Admiral Byrd's expedition, and later worked out the practical details under the sponsorship of the Institute of Inventive Research of San Antonio, Texas.

The modification consists essentially of producing the explosion above ground or above water, by the simultaneous ignition of a number of explosive charges so arranged as to produce a flat circular wave front. Energy applied in this manner assertedly passes through the highly elastic air medium and is absorbed over a relatively large earth surface area with very little loss—and therefore high efficiency of conversion to earth waves—as compared to the efficiency of conversion from a buried point source which is very poor because most of the energy goes to crushing or other movement of the rock or other surrounding material. It is claimed that, in addition to the obviously easier field operation, the records obtained on the portable seismographs contain more information and are more easily interpreted than those by undersurface explosions.

Time to Change Oil

A PERPETUAL SOURCE of argument or quandary among fleet or private automobile owners is the question of how often to change motor oil. At one extreme, many are persuaded to change every 1000 miles; the other extremists add only make-up oil over long periods, believing that, with adequate filtration to remove solid particles or sludge, proper lubrication will be obtained as the oil never "wears out." The overall economic answer is probably a combination of many items including type of oil, presence or absence of an effective oil filter, climatic temperature as controlling moisture condensation in the crankcase, degree of dustiness of atmosphere, general condition of engine, etc.

One answer has recently come from the Bureau of Federal Supply, the government's control purchasing agency, which has recommended that oil in the engines of government passenger cars, trucks and busses be changed only in spring and fall, or every 4000 miles, whichever period comes first. The bureau states that a technical committee on lubricants and liquid fuels has concluded that under normal driving conditions, with controlled preventive maintenance, oil changes at periods of less than approximately 4000 miles are unnecessary. While former procedures have not been stated, the recommended measures are estimated to produce a saving of 1.5 million gal. of lubricating oil annually, at a value of $500,000.

Thinking by Instruments

THE DECEMBER 1948 issue of *Instruments* Magazine, on its editorial page, speculates on probable developments in instrumentation in the near future, based on knowledge and experience at this time when the 20th century is almost half over and the "Nucleonic or Supersonic or some other Age" has passed its infancy.

It states that fully automatic analyzers and their associated chemical controllers will see extensive use in industry in 1949, but goes farther to say:

> Now for two specific short-range predictions—or, rather, two examples of one predicted radically-novel development, namely, the small "quick-review and quick-action instrument" which does to an *array* of instruments what is done today by the human being who uses such an array as one complex but coordinated means. We are not predicting "master controllers": they have already been designed for several arrays. What we predict is an instrument which will (1) make immediate "joint" or "integrated" reports on the time functions of the readings of the numerous already-installed measuring *and* automatic-control instruments: and (2) immediately carry out *in detail* the logical *broad* decisions of the human supervisor. One obvious application of this dual function is the array of all the flight instruments—including of course the autopilot—on a large airplane; another is the complicated array of a large chemical-process control board.

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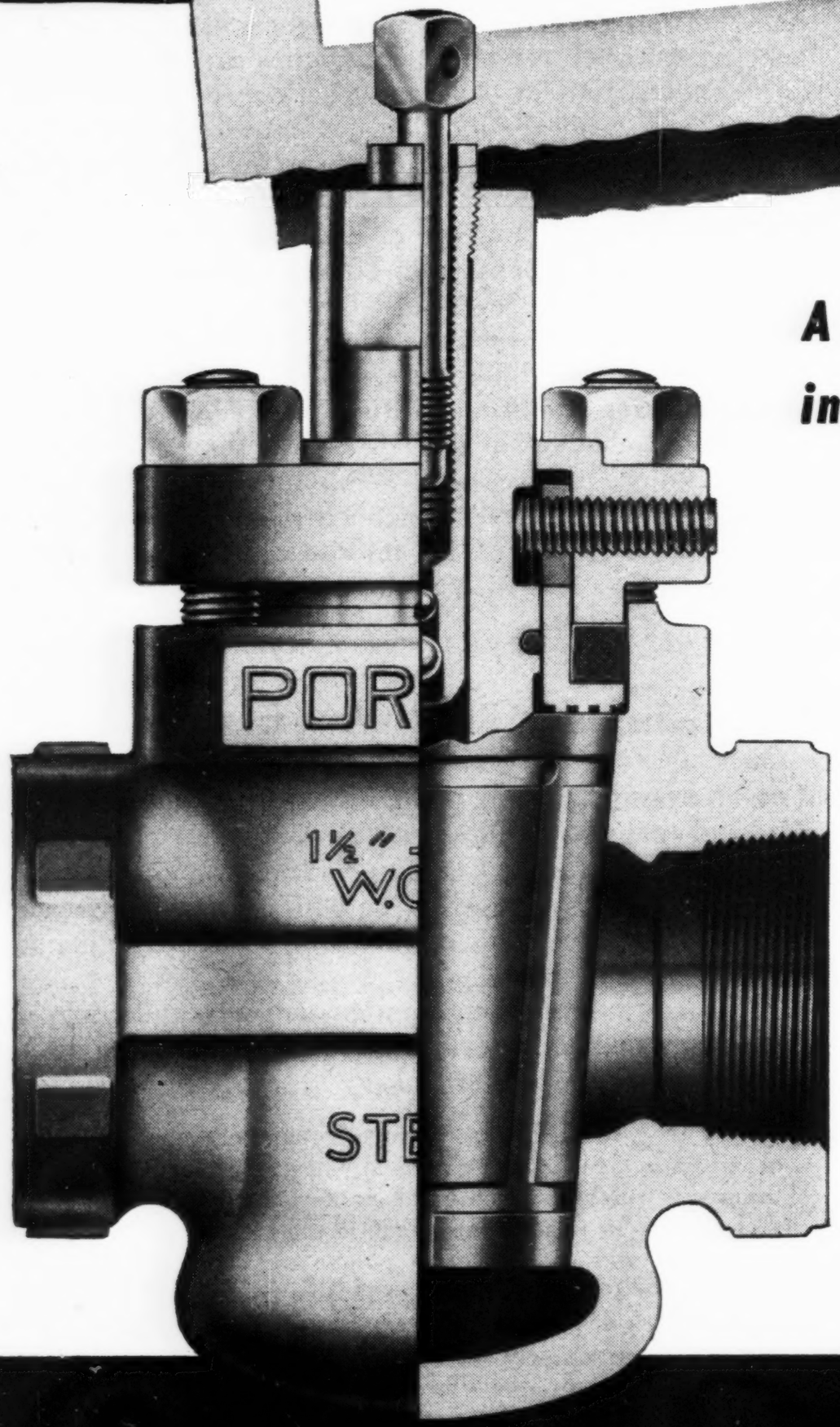

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PROMOTIONAL NOTES AND NOTIONS

by Stanley Jenks

Deserved Success

THE British *Gas Journal* is now celebrating the beginning of its second century of continuous publication. An editorial, reprinted from an early issue dated Jan. 10, 1853, reveals a publisher who, despite the moaners and groaners of those days, refused to be daunted or intimidated, and whose publication survived to serve the British gas industry in particular and the far-flung gas industry overseas, in accordance with the best traditions of constructive industrial journalism.

The first editor knew his classics too.

" 'Tis not in mortals to command success;
But we'll do more Sempronius—we'll deserve it."

For almost a century since that gas industry editor dedicated himself to deserve success by earning it, the gas industry has fought the good fight courageously and steadfastly for the public's betterment. Even its bitterest critic must concede that whatever measure of success it has attained has been thoroughly deserved because it has been earned the brawn and brainy way.

I believe my old friend Bud Rutherford, of Worcester, Mass., said it first: There's no fuel like an old fuel.

Appliance Simplification

OCCASIONALLY, SOMETHING APPEARING on this page stimulates more than the normal correspondence arising from our commenting on such a highly controversial subject as sales promotion in a local industry such as ours operating on a national scale.

Reviewing the files, perhaps the one item that really drew the bouquets was a paragraph written in the June 1946 issue. The subject was "Appliance Simplification," and, as a post-war suggestion for automatic water heaters, a plea was made to cut out the special local requirements and give the manufacturers a chance to mass produce their units.

"As a customer," I wrote, "I claim the whole domestic water heater field can be covered to the public's entire satisfaction by two or three, at the most, sizes of heaters. The resultant lower sales price, by making mass production possible, would more than offset the 1 or 2% efficiency that may be sacrificed."

Judging from the letters we received endorsing this viewpoint, the utility sales people and manufacturers definitely agree that fewer sizes and local frills would simplify sales. But it would seem the technical experts (utilization engineers?) still control the situation, because there are apparently available more sized models than ever and simplification seems even more remote. More's the pity, with the industry organizing to promote the GAMA automatic gas water heating campaign to be sloganed "For Hot Water Magic—Gas Has Got It."

Competitive Appliance Selling

JOHN A. HILLER, in a paper presented last November before a joint meeting of the Sales Managers Conference and the Manufacturers' Division, the New England Gas Assn., described the direct merchandising program of his company, the Portland (Maine) Gas Light Co. Mr. Hiller is sales manager, and calls the shots in Portland. Mr. Hiller evidently is a direct merchandiser of the old school, indicating that Portland may be one of those remaining exceptional places where it still is good gas utility practice to (1) figure everybody else selling gas appliances as "competitors," (2) pay outside salesmen commissions to take sales away from such "competitors," and (3) measure the extent of the sales effort in terms of volume of appliance sales per domestic meter. That's the way we used to talk in Indiana 25 years ago.

"I cannot help but wonder what this picture ($142,297 appliance sales by five outside salesmen) would have been had we chosen the alternative plan of depending upon furniture stores, new, inexperienced appliance dealers, and plumbers to do this job for us," stated Mr. Hiller. What "alternative plan?" Surely Mr. Hiller was not suggesting that the only alternative to direct competitive utility merchandising is to quit appliance selling entirely—a procedure that no responsible gas utility sales executive has ever endorsed.

The idea and objective of us sales cooperators is to find a plan whereby everybody who is willing and able to sell a gas appliance can do so profitably with the cooperation of the gas utility, which, however, stays in the appliance selling business for two main reasons: (1) to maintain a high appliance standard and (2) to sell those load-building appliances which the dealer won't or can't.

And as for the dealer "selling the customer electric, oil or gas appliances, depending upon their indicated preference," a utility itself is doing what Mr. Hiller accuses the dealer of doing, that is, taking the line of least resistance, when it is content to recognize such a dealer condition and do nothing to make it easier and more profitable for the dealer to sell gas appliances rather than electric or oil. But fighting him for his merchandising profit is no way to win him as a sales ally.

"Biggest Inch" Blythe

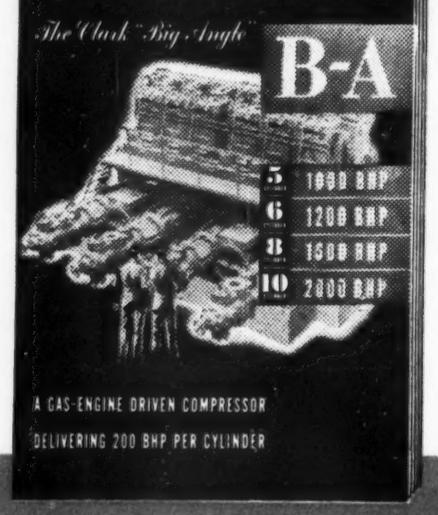
. . . puts 7 Clark "Big Angles" on Texas-California Pipe Line

The new Blythe booster station of the Southern California Gas Co. and the Southern Counties Gas Co. is the California link in the big pipe line from the Texas fields to the Los Angeles area. Blythe receives the gas from the El Paso Natural Gas Company, whose nearest booster station is at Gila Bend, Arizona, 140 miles east.

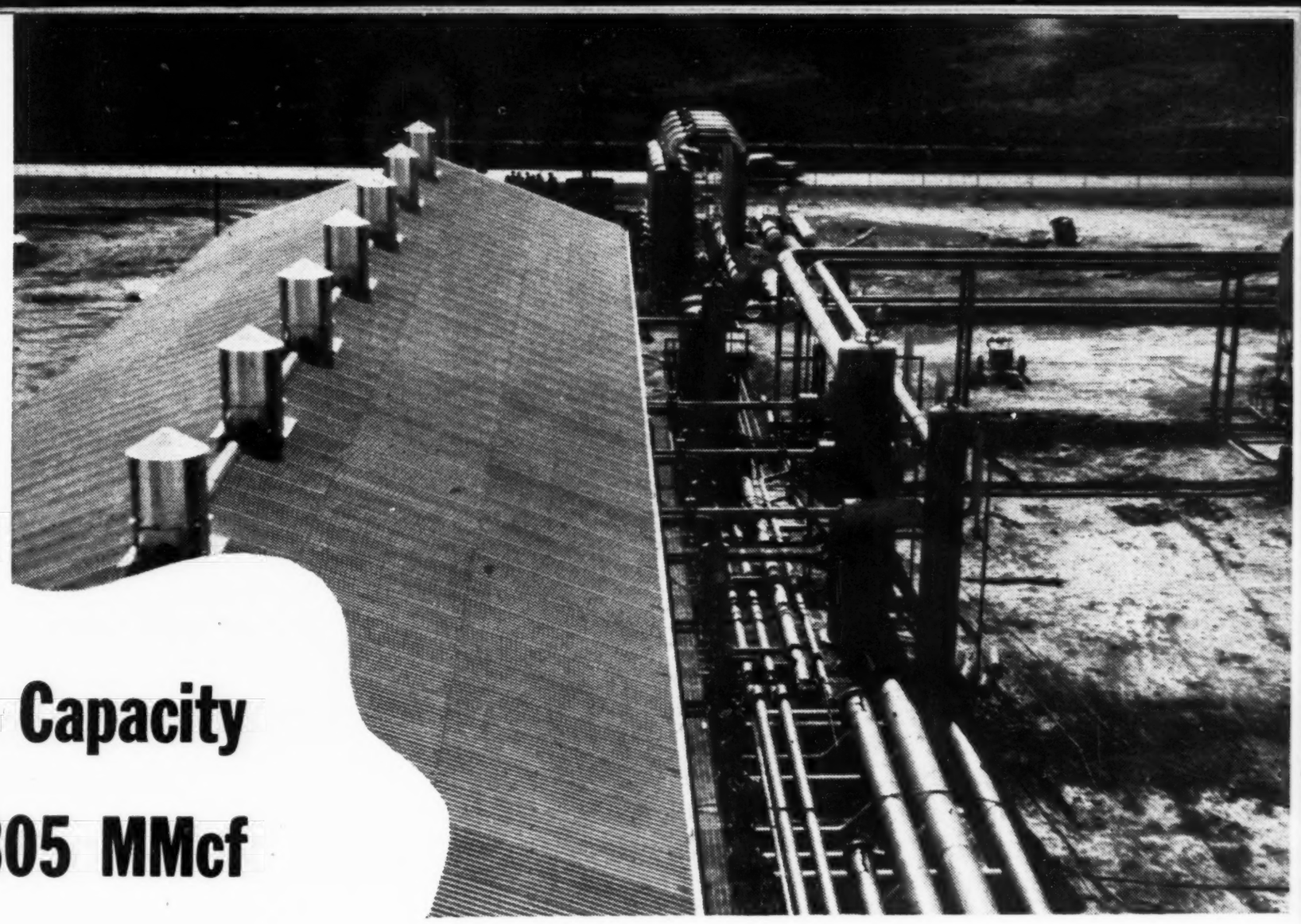
Activation of this new station increases the flow of Texas gas from 175 MMcf per day to the full designed capacity of the station of 305 MMcf per day. That means energy equivalent to the output of six Boulder Dams carried through the largest diameter, high-pressure gas transmission line ever built.

The Clark "Big Angle" installation consists of seven 8-cylinder, 1600 BHP compressor units with a total of 11,200 BHP. The compressors operate with a suction pressure of 350 to 500 psi and a discharge pressure of 680 to 800 psi.

Write for new bulletin on the Clark "Big Angle". It contains detailed information, dimensional drawings and other useful data.



CLARK "BIG ANGLE" COMPRESSORS



View from atop jacket water cooling tower showing auxiliary building roof, scrubbers, piping.

New Station Boosts Capacity of Biggest Inch to 305 MMcf

By J. A. MILLEN and H. C. VANDER HEYDEN

ON Oct. 30, 1947, Texas gas was first delivered across the Colorado river just east of Blythe, Calif., into the 30-in. pipeline of the Southern California Gas Co. and the Southern Counties Gas Co. of California. By Jan. 10, 1948, Texas gas was being received into the system from El Paso Natural Gas Co. at the rate of 175 MMcf per day. This rate was gradually increased until an average of over 215 MMcf per day was being received during December, 1948.

Exclusive

Meanwhile, in order to meet the ever-increasing demand for natural gas in southern California, work was started early in 1948 on the construction of an 11,200-hp compressor plant near Blythe to increase the capacity of the 30-in. system to its presently designed rate of 305 MMcf per day.

The plant was placed in operation late in December, 1948 and by Feb. 15, 1949, Texas gas was being delivered through the plant into the 30-in. system at the rate of 305 MMcf.

Physical Layout

The station, including the plant and cottages, occupies 17 acres of a 40-acre site and is a joint accomplishment of Southern California Gas Co. and Southern Counties. It is located 3 miles west of Blythe in the Palo Verde valley and is a half mile south of Highway 60 and 6½ miles west of the Colorado river.

Water, electric power, fire protection, air conditioning and—of course—gas for all needs are supplied right at the site. Nine homes for maintenance and operating personnel and their families, along with the various components of the plant itself, draw from these facilities.

In the westernmost sector of the yard are two wells, which supply all the station's water needs; a fire pump house, three 2200-bbl water storage tanks, two for raw water storage and one for treated water; and four 6000-gal oil storage tanks, enclosed by a concrete-diked firewall, used for storing scrubber oil, main engine lubricating oil, auxiliary engine lubricating oil, and used lubricating oil.

North of the two main buildings, which are in the center of the plant area, are two cooling towers. One is a two-cell gas cooling tower and the other a four-cell jacket and oil-cooling water tower. East of the main buildings are locker and lavatory building, an operating and office building for pipeline maintenance personnel, a complete garage unit shared jointly by plant and pipeline operators, and, at the far east, the nine six-room houses occupied by personnel attached to both operations.

South of the two main buildings are the intake meters and gas scrubbers. Gas from the 30-in. pipeline, which passes along the southern edge of the property, enters the plant and is measured through five 16-in. orifice meters, thence passes through five Blaw-Knox gas scrubbers before entering the plant suction header. The scrubbers are 18 ft high and 60 in. in diameter and each will process 70 MMcf every 24 hours.

Mr. Millen is manager of the Texas pipeline division for Southern Counties. Mr. Vander Heyden, Southern California Gas Co. design engineer, has been on special assignment to Southern Counties as resident engineer in charge of construction of the Blythe plant.

The main building and center of interest is the compressor building, measuring 242 ft in length and 44 ft in width. Only the compressors and appurtenant equipment are contained in this structure, owing to possible fire hazards. A Class B hazardous location, all of its electrical equipment and instruments are explosion-proof. Fluorescent lights are completely sealed and the electric clock located in this building has its mechanism housed in a separate sealed case, its motive power being transmitted through a stuffing box.

Compressor Equipment

Seven Clark BA-8 right angle compressors, gas engine driven, are now installed and operating with a suction pressure of 480 psig and a discharge pressure of 807 psig. Foundations within the building and necessary piping are already in place for the installation in the near future of two additional compressors. The two additional units, increasing the capacity of the plant to 405 MMcf per day, will be installed as soon as added pipeline facilities can be constructed to deliver an added 100 MMcf per day. The compressor engines now in operation are rated at 1600 hp each and have eight 17-in. bore by 17-in. stroke vertical power cylinders directly connected to four 9½-in. bore by 17-in. stroke horizontal double-acting compressor cylinders. Fluor pulsation dampeners are installed on both the suction and discharge side of each unit. Each engine exhausts through heavily insulated piping into a horizontal Maxim silencer, which aids in keeping noise at a minimum.

The main engine room has colored concrete floors, colored equipment bases and a sub-basement running the full length of the building for piping areas. The building itself is a steel frame structure of rigid design, with flat transite sidewalls and corrugated transite roofing. The north wall is constructed so that it can be temporarily detached at the time the two additional engines are installed on the existing foundations. A considerable effort was expended to assure dust-tight construction of the building—webbing was installed around the doors, windows are non-opening, and all joints are sealed with mastic. Ventilation is provided by roof ventilators having dampers for closure during dust storms. But for these precautions, dust carried by winds off the hot dry desert would soon jeopardize the efficiency of the expensive equipment installed in the plant.

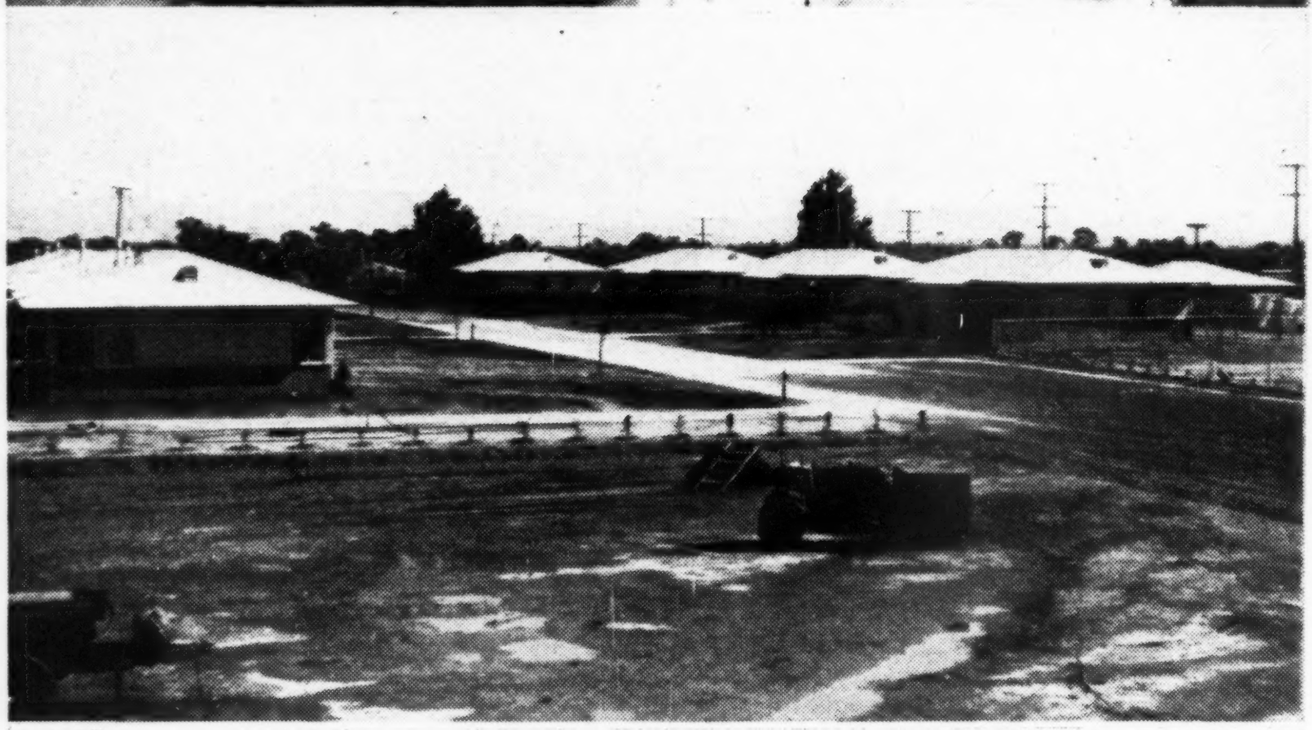
Auxiliary Building

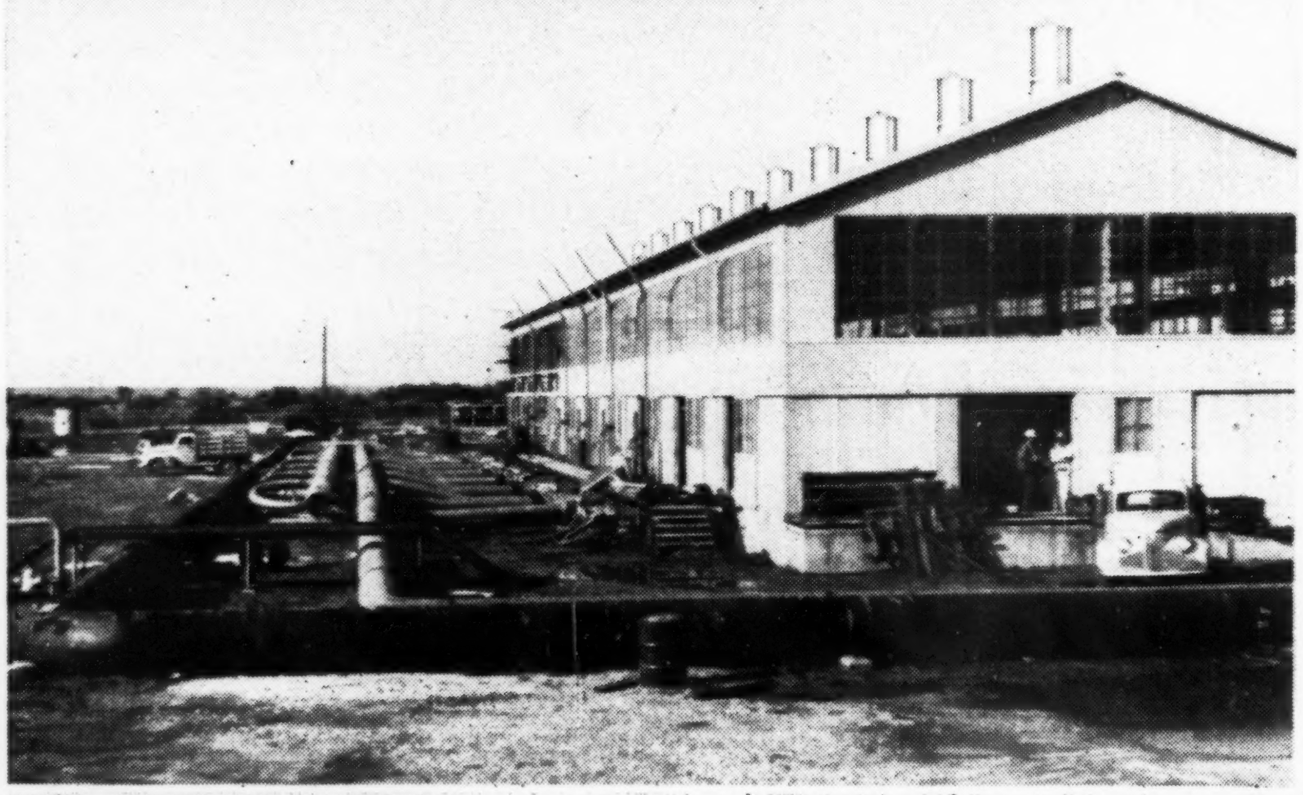
The auxiliary building located just east of the compressor building is 38 ft by 162 ft and is similar in construction to the compressor building. This building houses the plant office and machine shop, which together occupy the entire south end, a water softening system, auxiliary engines, a central refrigeration system to cool employees' homes, electric generating units—providing a dependable water supply—cooling water pumps and air compressors.

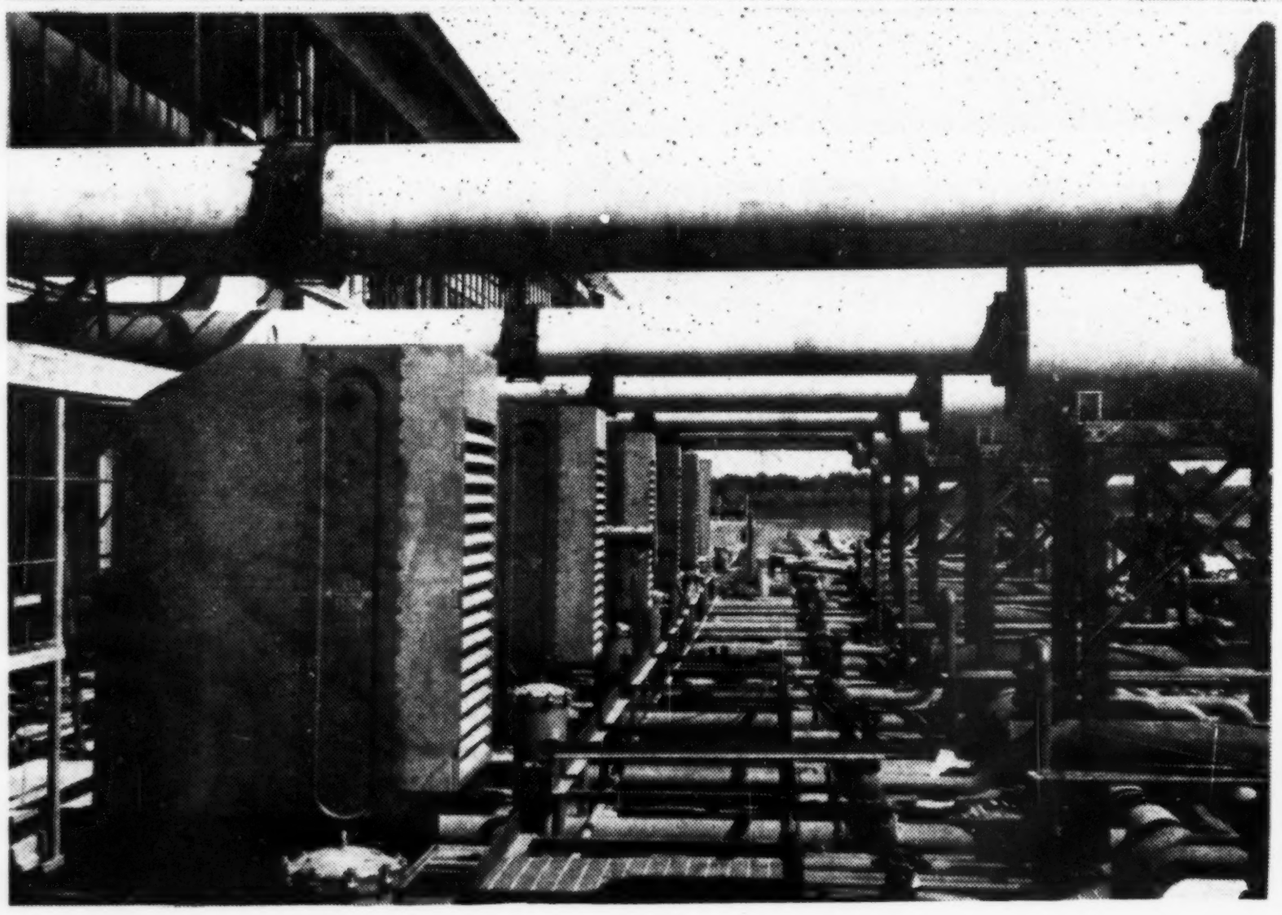
Three motor generator sets, each having an output of 250 kw, are employed. Ingersoll-Rand PVG-8 gas engines, each rated at 370 hp and having an 11-in. bore and 13½-in. stroke, drive General Electric generators through direct connection. The three generators produce 440-volt, three-phase 60-cycle current sufficient for powering all motors and providing all lighting in the plant and in adjacent buildings and residences.

Starting air is furnished by two Ingersoll-Rand compressors located in the auxiliary building, one operating on gas and the other electrically driven. These also provide instrument air at 150 psig and air at 100 psig for utility uses. In putting the plant's equipment into operation, the gas-fuel compressor is started and pumps air at 250 psi into three receivers, which measure 12 ft in height and 48 in. in diameter. At this pressure, the air is utilized to start the engines on the motor generator sets, which in turn provide current to run the pumps and the electric motor-driven air compressor. Thus, the gas engine unit is utilized principally for starting and standby purposes.

Safety is built right into the system. All exposed moving parts are covered

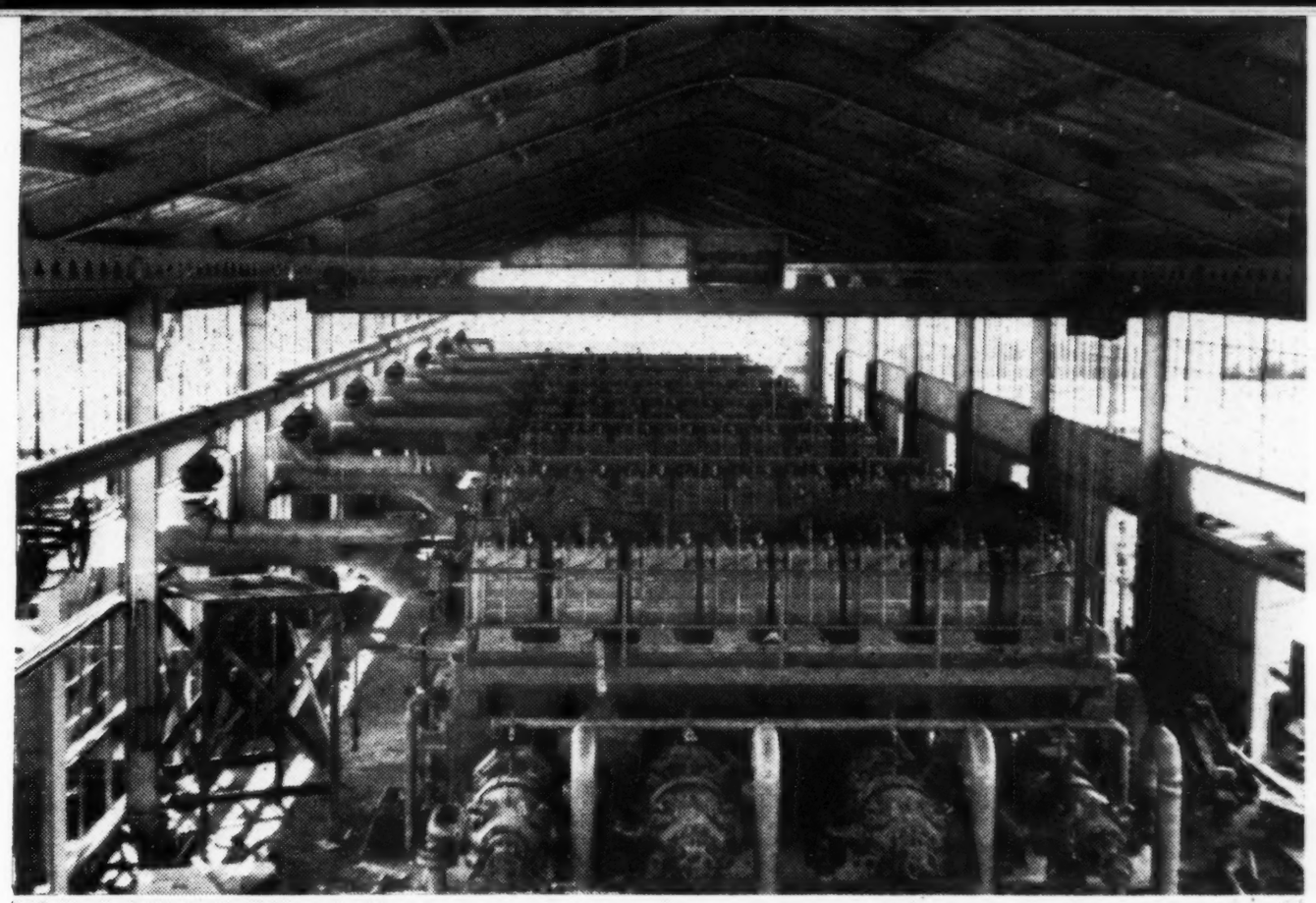






COUNTERCLOCKWISE

Two of three Ingersoll-Rand generator engines in place in auxiliary building. Generator motor in place on engine in rear.



Residential area. The nine 6-room homes are occupied by families of plant and pipeline personnel.

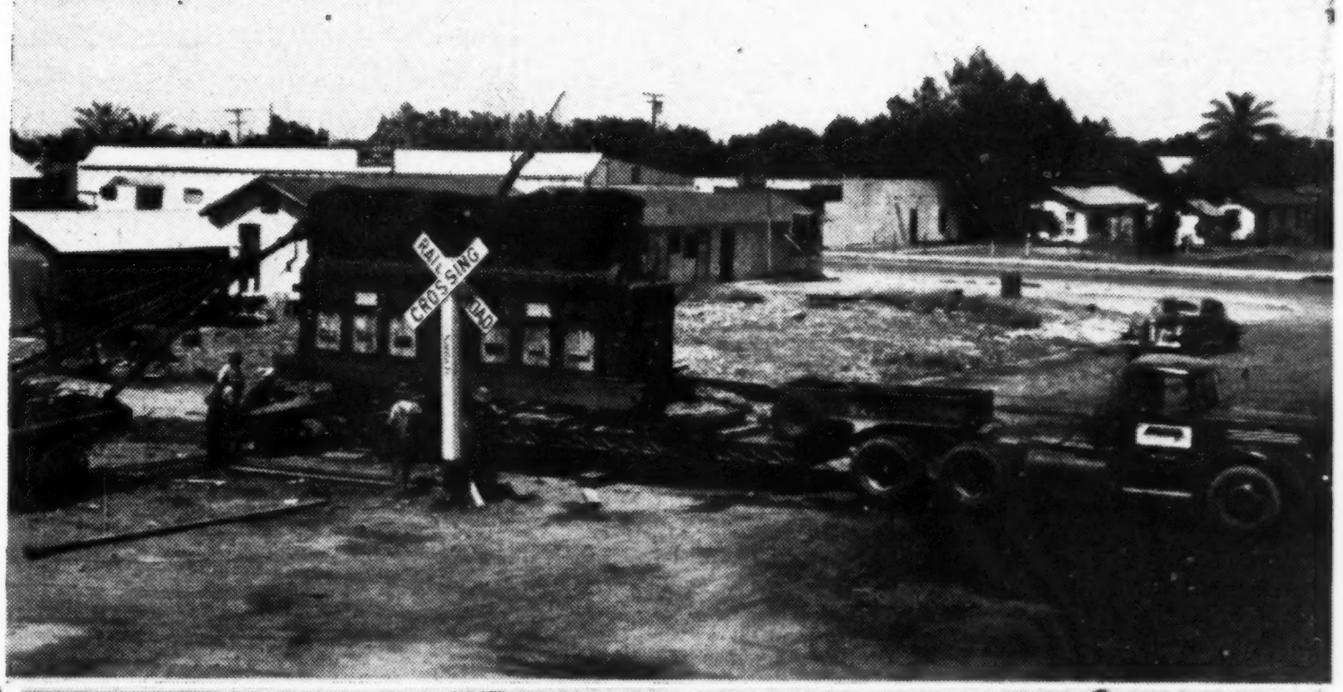
West side of compressor building, with intake and discharge lines.

East side of compressor building, showing exhaust lines, Maxim silencers, air filters, oil coolers, grating, miscellaneous piping.

Four-cell Fluor induced draft jacket water cooling tower.

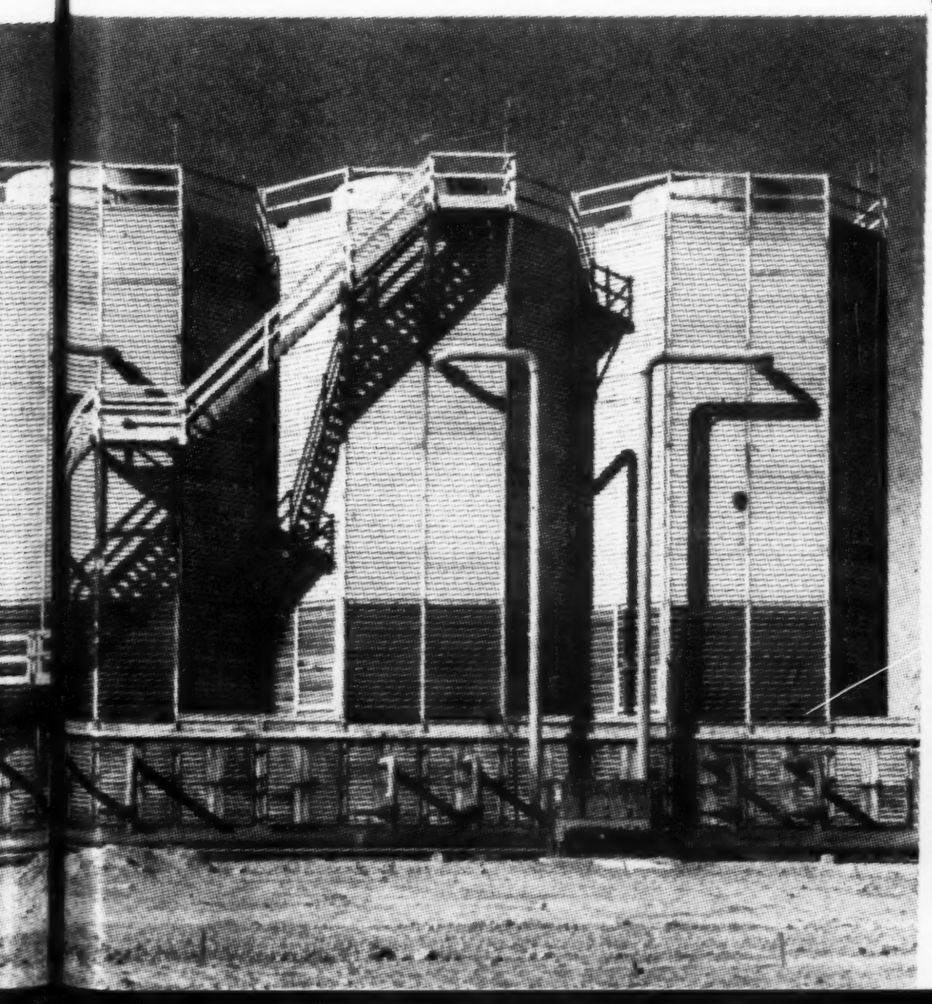
View from south side of station showing changes being made to scrubber piping. In center foreground, suction header from the Texas line rises out of ground. Installed on it is piston-operated valve, a part of emergency shutdown system. It is operated by remote control from any one of five stations located throughout plant. Left of it is bypass used in case of plant shutdown. In background, compressor, auxiliary buildings.

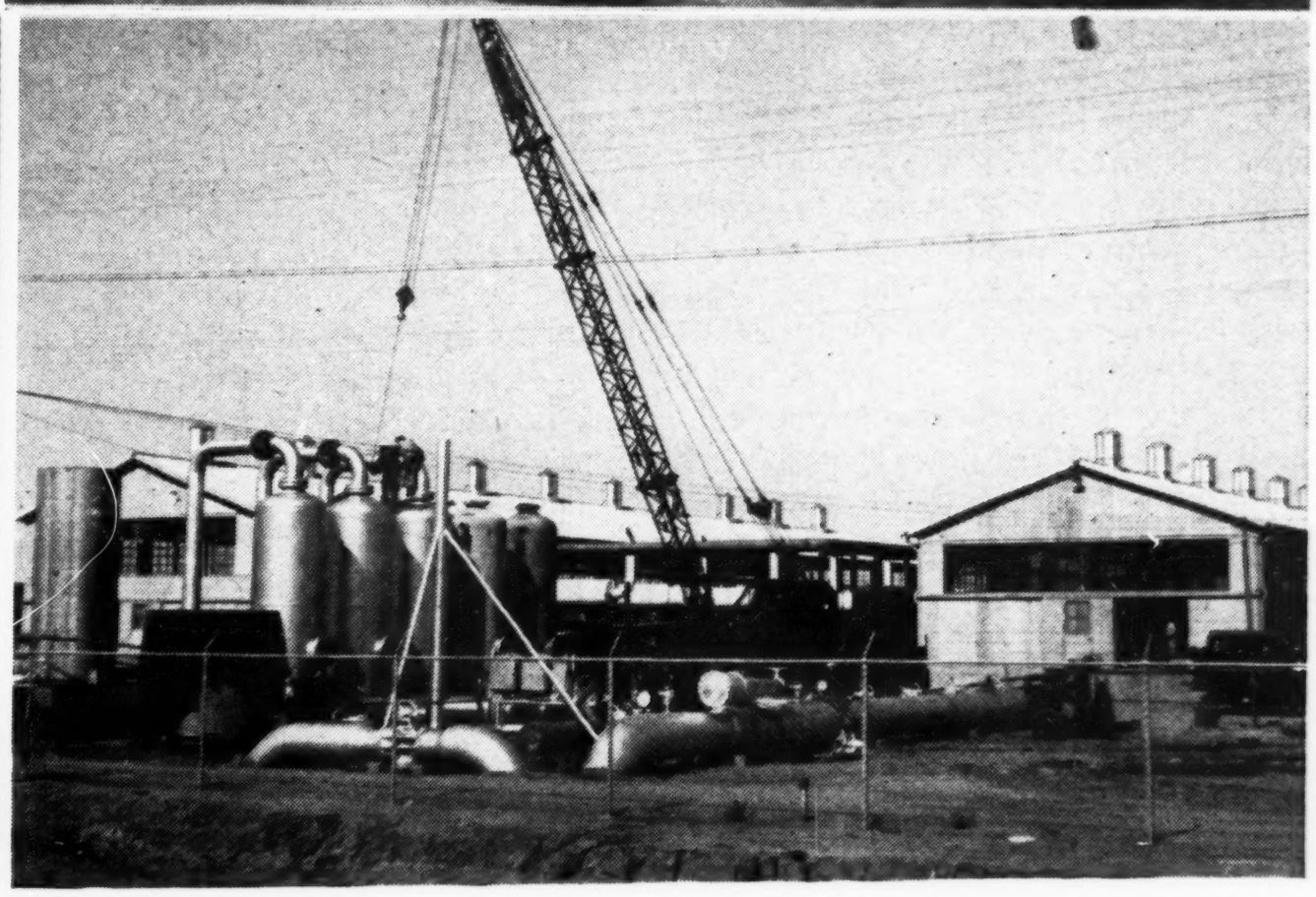
One of the seven engines leaving railroad spur at Blythe. Unit sits on low bed truck and house-moving dollies ready for trip to site.



West end of plant yard showing scrubber oil tank being set in place. Also evident in same group are tanks for storing clean lubricating oil and used lubricating oil. At right, three water storage tanks, two for raw water and one for treated water, and the fire pump house. At left, compressor building; running out of photo are headers leading to gas cooling tower.

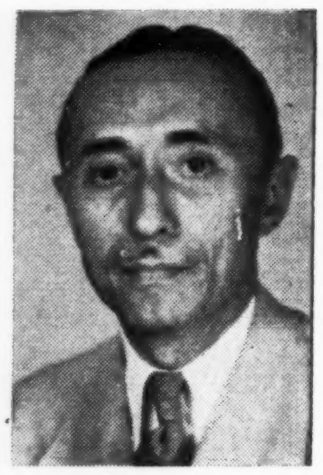
Seven angle-type Clark compressors boost gas from 480 to 807 psi.





THE AUTHORS

J. A. Millen



H. C. Vander Heyden

to comply with the state's industrial safety code. The fire-pump house, a 14 by 20 ft building, constructed of the same transite material as the main and auxiliary buildings, is located at a comfortable distance from the rest of the plant. The two wells which supply it are also isolated from the plant as well as from each other, and the storage tanks are considerably removed from any likely hazards. The pump house contains two fire pumps, each of which independently will pump up to 500 gpm at 125 psi. One is gas engine-operated, the other electric motor-driven. These supply a dozen dual hydrants, eight of which are installed in scattered and strategic locations through the plant yard; three others serve the residences and one the garage. The electrically-driven pump has a 50-hp motor connected to a Worthington Pump while a Waukesha gas engine powers an Aurora pump.

Fire Protection

These facilities work hand-in-hand with an emergency shutdown system to assure plant protection in case of fire or explosion. Five emergency plant shutdown stations comprise this system. At any one of these, which are located at various points about the plant yard, an operator, by opening a Nordstrom valve, can reduce the pressure in the emergency shutdown header, which closes two piston-operated Nordstrom valves, one on the 30-in. suction header and one on the 30-in. discharge header, where they enter and leave the plant. This action also automatically opens a piston-operated valve, which bleeds down all high-pressure lines except the fuel supply to the three motor generator sets and the fire pump.

In case of extreme emergency, virtually complete shutdown of the entire plant is possible without interrupting the operation of the fire protection system. This is made possible through a direct line from the Texas pipeline to the engine-driven fire pump, which enables shutting off the fuel supply to the motor generator sets without affecting the gas engine fire pump.

Chief criteria in the selection of the type of cooling equipment—Fluor induced draft—were the conditions of temperature and atmosphere. The extreme humid summer heat in this locale demands high standards of performance and a broad range of cooling. Both towers are of all-redwood construction with all exterior exposed wood surfaces treated with a special preservative which gives protection against the extreme temperatures.

Both towers operate in a single stage with two-pass cooling coils. The two cell gas cooling tower measures 28 ft in width by 52 ft in length, and is 31 ft high. It has a capacity of 2400 gpm; water entering the tower at 97° leaves at 86° at 80° wet bulb. Gas is cooled from 125° to 95° at 807 psi.

The jacket water cooling tower, a four-cell model, measures 28 by 100 ft and stands 47 ft high. Its capacity is 5000 gpm at 105° intake temperature, 85° out at 80° wet bulb. Temperature of jacket water for the motor generator sets is 160° out and 150° in.

The fan in each of the six cells is powered with a two-speed motor, which permits high speeds in summer and low speeds in winter.

Water System

Water itself was an extremely important item in designing the station layout. In addition to equipment cooling and fire protection application, it was needed for all-important air conditioning and other uses in the residential section. The company was fortunate in having a high water table at the site. Average standing water level is 8 ft, and with both wells down 325 ft an adequate supply is constantly assured. Two-stage Peerless "Deepwell" turbine pumps deliver more than 425 gpm each.

All water except that used in the fire protection system and for residential lawn sprinklers is softened before it is used. Its salt content of 16 grains per gal makes it advisable to treat it for other applications in the plant. To accomplish this softening, the company has installed in the auxiliary building two Permutit fully automatic zeolite units, each with a capacity of 265 gpm. One Wallace and Tiernan hyper-chlorinator chlorinates ahead of the softener, and one chlorinator is installed downstream of the softener. This equipment assures control of algae in the softening bed as well as in the two cooling towers.

Flow of water in the system is automatically controlled by demand. Water flows directly from the well to the two 2200-bbl raw water storage tanks, whence it is drawn for use in the fire system and the lawn sprinkler system, and for the soft water treatment. A float switch automatically actuates the well pumps when the supply falls below a set level. Makeup water for the soft water system flows from the raw water storage tanks to the softener, and thence into soft-water storage, a 2200-bbl capacity tank located alongside the raw water tanks. This tank likewise controls intake by demand on the softeners.

Air Conditioning

The air conditioning system for the residences, a "must" job on this installation, held a high priority in construction. In order that families might be able to withstand the rigors of last summer, this system was placed in operation before other equipment had been installed—even before the building which houses it was erected. It is a central chilled water system, circulating water cooled to 38°F to the nine residences.

The employee residences themselves were designed for comfort, utility and beauty. Forced air unit heating was installed in each. All have six spacious rooms, with three bedrooms.

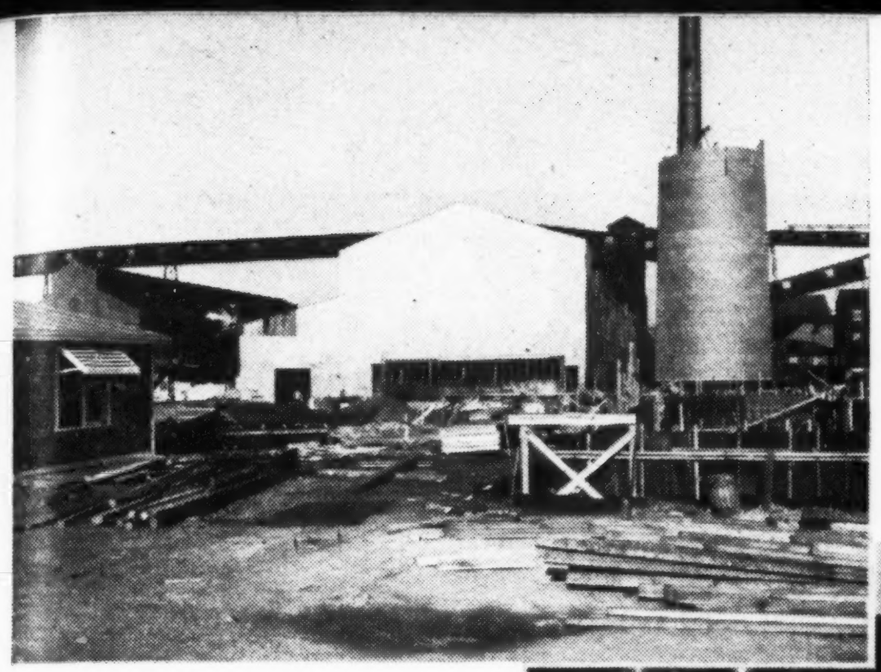
Installation of the 60-ton compressor engines on the fine desert silt posed extra problems for the construction crews. Because of the high water table the foundations were poured on one slab 22 in. thick and heavily reinforced, over specially prepared decomposed granite subsoil. This subsoil was carefully compacted to give a steady base for the units.

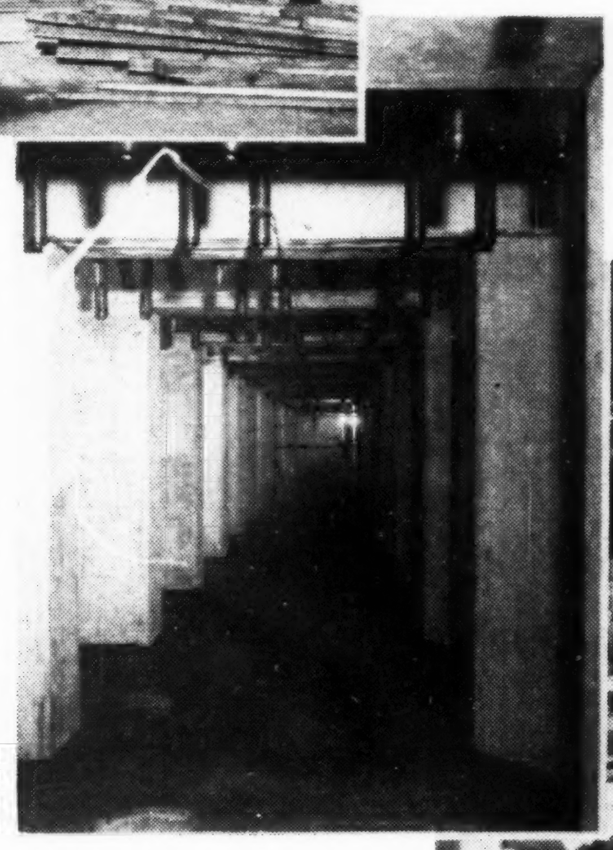
The location, being some 230 miles from Los Angeles, necessitated long distance transport of materials as well as aggregate for concrete. The compressor engines were shipped to Blythe in railroad gondolas and transferred to the station site three miles away by low bed trailer and house moving dollies. The moving job required 3½ days per engine. Engineers walked alongside the moving dollies the entire distance to guard against mishap.

Twenty-seven hundred yards of concrete was poured on the job. Because of the scarcity of proper ingredients in the desert, sand and rock were imported from the San Gabriel wash near Los Angeles.

Corrosion protection was an important factor in the design of the plant. As the soil is highly alkaline, it was decided that all major pipelines should be above ground. This of course also gives faster leak detection. Integrity of pipeline welds was checked before the plant was put into operation, with both field and prefabricated welded joints of high pressure gas headers being gamma-ray inspected.

Versatile Chicago Coke Oven Battery Near Completion





CONSTRUCTION SHED which was erected over bricklaying and piping installation to enable working during winter. New stack at right; old stack behind it.

BASEMENT directly underneath ovens, with 2½-in. risers for fuel gas which is used in firing ovens.

GENERAL VIEW of construction shed interior, bricks are stacked in readiness for the bricklayers.

By WILLIAM HELME

CONSTRUCTION work on a new battery of 51 Koppers-Becker low differential underjet by-product coke ovens, which Koppers Co. Inc. is building for The Peoples Gas Light and Coke Co. at its Crawford avenue by-products plant, is now well underway and indications are that the ovens will be ready for operation sometime this summer.

Exclusive

The excavation work on the site for the new ovens was started on Feb. 1, 1948. Machinery for driving piles was moved in and that part of the job was completed March 18. During the summer, carpenters were at work constructing plywood forms for various stages of concrete pouring. The foundations, of reinforced concrete, were completed Sept. 18. Brick laying was started about the same time.

Winter Shield

During the construction, a large shed has been built over the entire area on which the ovens are being built and heaters installed. With the mechanics thus protected from the wintry blasts, the laying of brick and the installation of piping has been possible all winter.

The new battery of coke ovens is being so constructed that it can be fired with coke oven gas, water gas, producer gas, natural gas, refinery gas, butane gas, or propane gas. So far as Koppers Co. knows, it is the first battery to be constructed in this country with such versatility in the gases that may be used.

Each of the 51 ovens will have an average width of 18 in. The length of each, from face to face of brick work, will be 40 ft 3¼ in. Height from oven pad to top of battery will be 27 ft 1 in. Each oven will take a charge of 15.1 tons of coal, and the entire battery will carbonize approximately 1000 tons of coal each 24 hours.

The contract does not call for any additions to The Peoples Gas Light and Coke Co.'s by-product equipment, since the present facilities are adequate. Koppers is furnishing a new larry car, which is used in charging the ovens, and a door machine, which is used for removing the doors before the coke is pushed, and is building an 80-ft extension to the coke wharf and conveyor system. A quenching station, in which strong sprays of water will be used to smother the glowing coke after it comes from the oven, also is being built.

When the construction is completed, the ovens will have to be heated slowly for approximately six weeks before carbonization of coal will start. This long period is required in order that the new bricks and mortar will be allowed to expand without cracking. In this six weeks period, the ovens will be brought from atmosphere temperature up to a temperature in the vicinity of 2100°F. Once this heat is attained and carbonization starts, by-product coke ovens may be in continuous operation for as long as 25 or 30 years.

Another feature of this installation will be a Koppers-Elex Precipitator, which will clean tar from the coke oven by electrostatic means. There are times when a portion of this coke oven gas may be used for underfiring. In this system of cleaning, the gases pass into a chamber through wires which have a positive charge of electricity. The particles of tar are given a negative charge. As they pass on, they come in contact with large plates which are positively charged. The positively charged plates attract the particles of tar and hold them. The tar can then be recovered and sold.

Smokestack

The smokestack discharging the waste heating gas from the battery of ovens will be 8 ft in diameter, inside measurement, and 250 ft high. It will carry two lightning rods, each of which has an 8 ft tip made of monel metal. The monel metal is used because it is resistant to corrosion.

The additional ovens, to be built at a cost in excess of $4.5 million, will increase the present carbonizing capacity by approximately 40%. Gas from these ovens will be mixed with natural gas for domestic and industrial use. The coke made here is sold to industry for use as domestic fuel, and is also used in the production of water gas.

PLANT OPERATION IN RELATION T

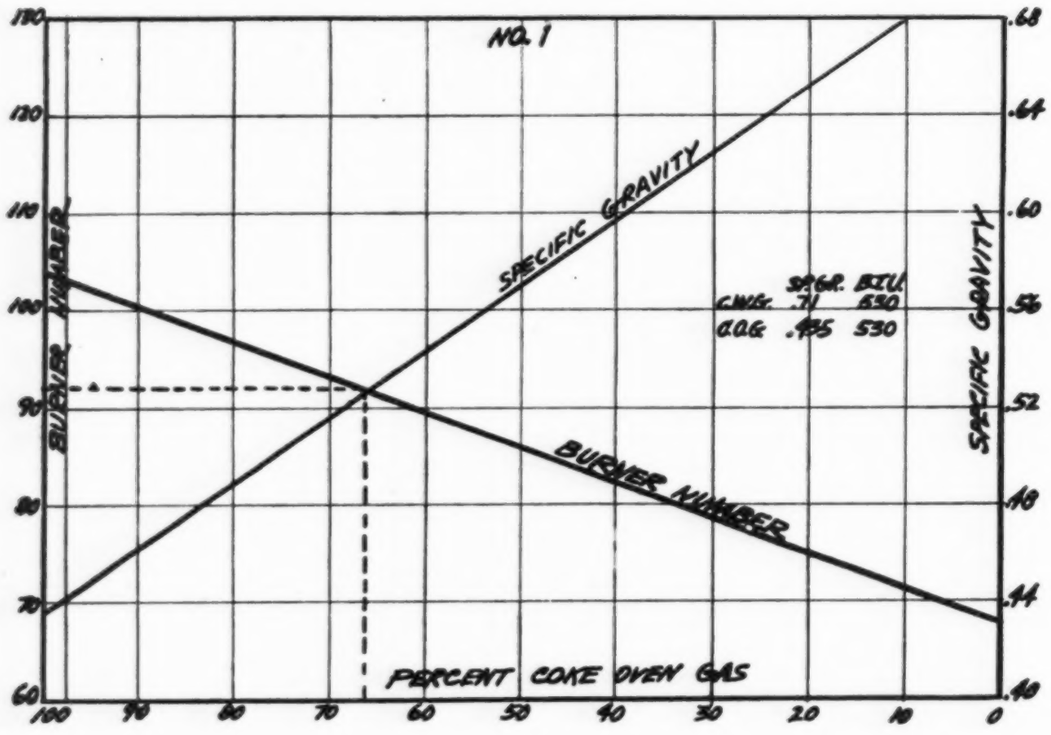


Fig. 1. Rochester burner numbers for coke oven-carburetted water gas mixtures.

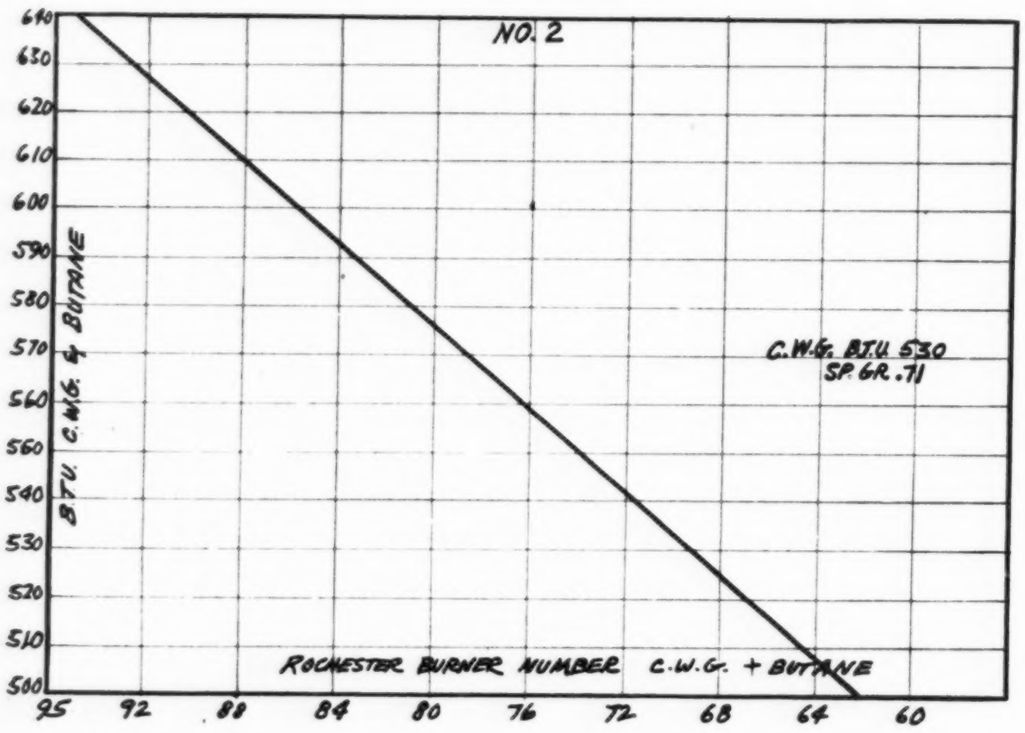


Fig. 2. Cold enrichment of carburetted water gas with butane.

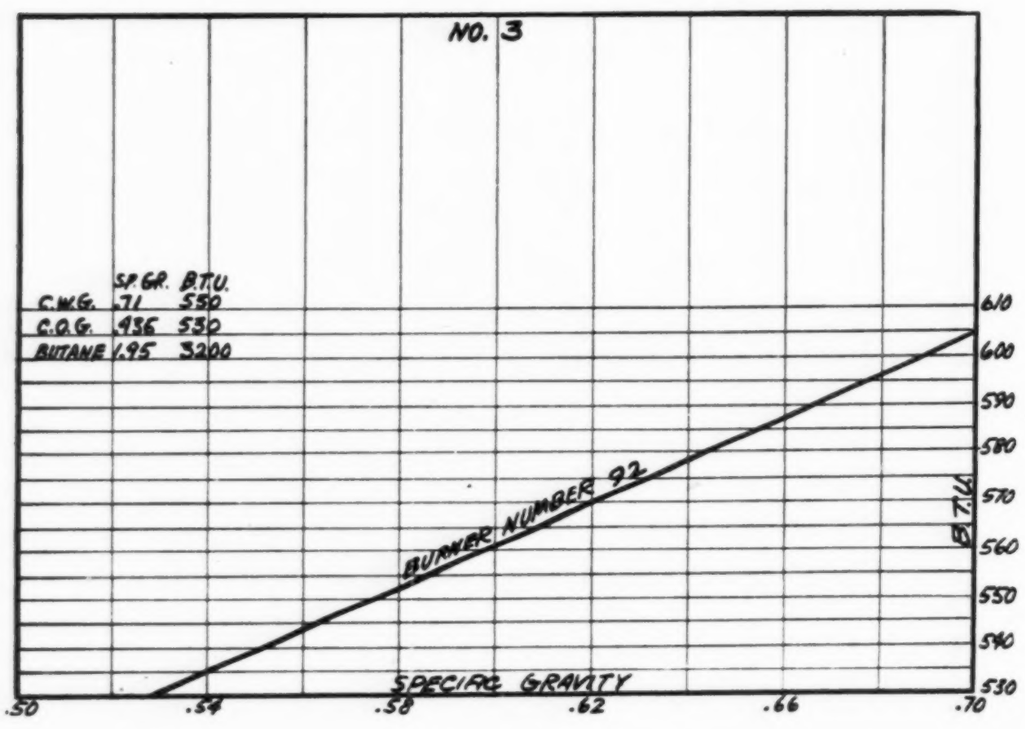


Fig. 3. Specific gravity-Btu relationship of coke oven-carburetted water gas plus butane to maintain Rochester burner number of 92.

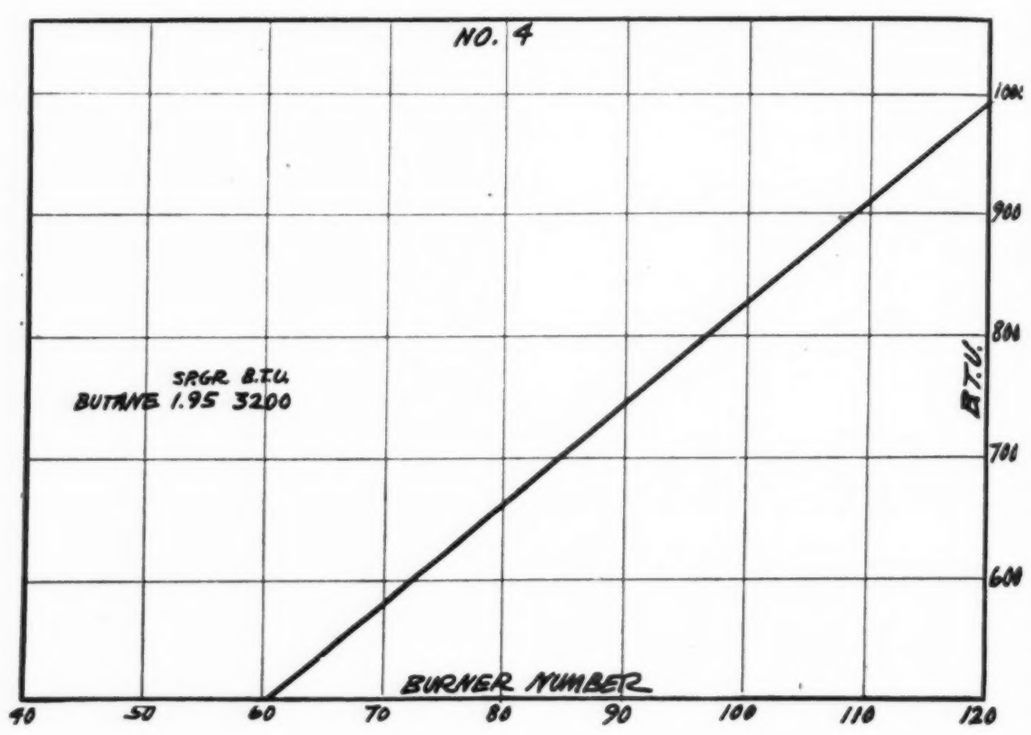


Fig. 4. Burner number-heating value relationship of butane-air.

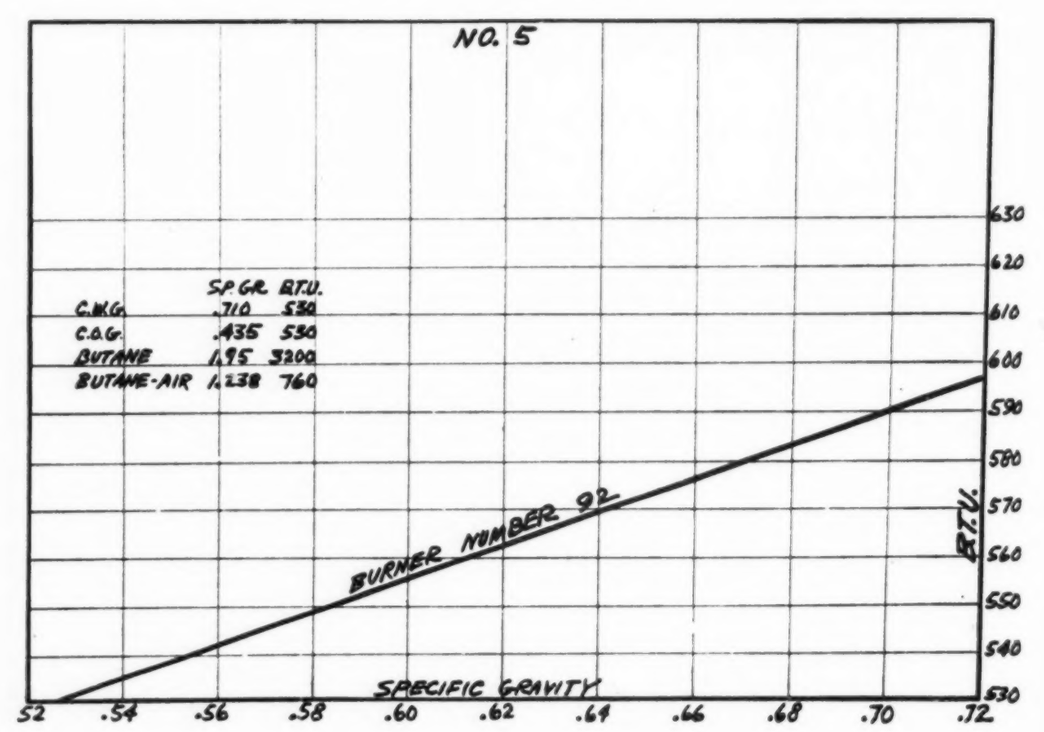


Fig. 5. Specific gravity-Btu relationship of butane-compensated coke oven-carburetted water gas plus 760-Btu butane-air.

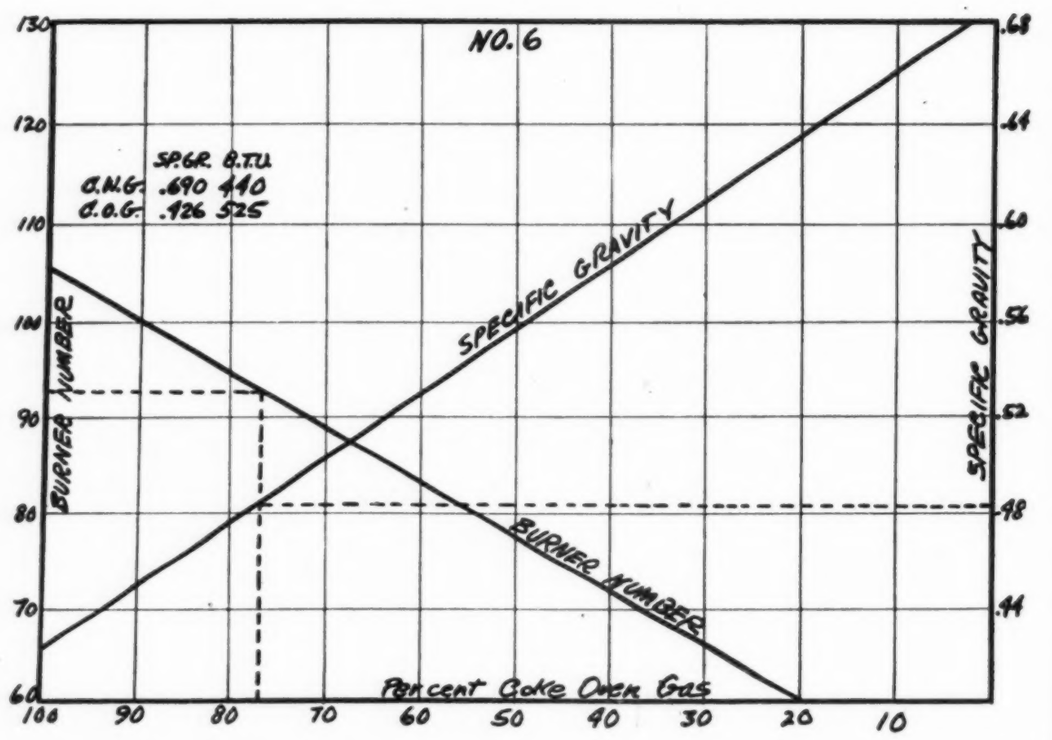


Fig. 6. Rochester burner numbers for coke oven-carburetted water gas mixtures.

TILIZATION

A study of the combustion characteristics of sendout gases to determine limits of satisfactory appliance operawhen peak loads require interchanging of gases.

By **WARREN E. CHURCHILL**

THE present day gas plant operator may now be called upon to use as many as six or seven different gases in obtaining the necessary production rate to meet winter load conditions.

When it is considered that he must not only gauge his production rate properly, making due allowances for the unexpected departures from the weather predictions, but must also deliver a sendout gas which will burn with characteristics closely approaching those on which the customer appliances have been adjusted, the need for an additional operation guide is apparent.

The specific gravity recorder and recording calorimeter are now indispensable to the operator but with the third factor, "combustion characteristics," still unmeasured, he cannot have direct control of this important property.

The need for an instrument which will indicate and record the combustion characteristics of fuel gases has been realized for years but as yet the difficulties involved have so far been insurmountable.

In 1940 a valuable contribution toward the solution of this problem was made by Louis Shnidman and Jesse S. Yeaw of the Rochester Gas & Electric Corp. with the publication of "Determination of the Combustion Characteristics of Fuel Gases," and "The Test Burner and Its Application in the Control of Gas Quality."

The authors showed with complete test data and curves that, by calibrating a relatively simple test burner on the gases covering the normal sendout range, it was then possible to use this burner in testing the combustion characteristics of new mixtures to determine their fitness as supplemental gases.

In this work it was also pointed out that mixtures of natural gas with flue gas or air gave results on the test burner which were misleading if the "burner number" alone was considered. Fortunately the "flashback" or "blowoff number" also obtained on this same burner permitted unusable mixtures of this type to be identified.

In 1941 the writer had a test burner made according to the description given for the "Rochester Test Burner."

At this time the burner was used to collect data on what was considered to be our normal sendout gas. Then, later readings were taken when variations occurred in the character of the gas during peak loads.

During this period we operated on coke oven gas six months of each year, which meant that many of our appliances were adjusted for normal operation on a .40-specific gravity, 530-Btu gas. Meeting peak loads with carburetted water gas gave a specific gravity range from 0.36 to 0.48 from summer to winter operation. When the specific gravity reached .45 or higher our customer complaints increased to two or three times the normal figure.

As the following work has been done with the aid of the Rochester type test burner, its operation is reviewed briefly at this time.

It consists of an ordinary laboratory bunsen burner which has been fitted with a graduated dial on the primary air shutter and a flame hood set with its upper edge exactly 1 in. above the edge of the burner port. A fixed orifice having a No. 66 M.S.D. opening is installed in the place of the original needle valve. Gas is supplied to the burner at 3.0-in. water column pressure, using two small regulators with an adjustable bleed burner between them.

Under normal circumstances the pressure can be checked on the water-filled manometer and readily adjusted when necessary with the needle valve on the bleed burner.

The tendency for a gas to give luminous flames is measured on the test burner by adjusting the primary air shutter until a faint luminous tip appears. The reading thus obtained is called the yellow tip (YT) number.

The next reading, called burner number (B), is obtained by opening the primary air shutter until the inner cone of the flame is exactly one inch high. This cone height is determined by sighting across the top of the flame hood.

The final reading called either the flashback number (FB) or blowoff number (BO) is obtained by slowly opening the primary air shutter until the flame either lights back on the orifice or blows off the burner port.

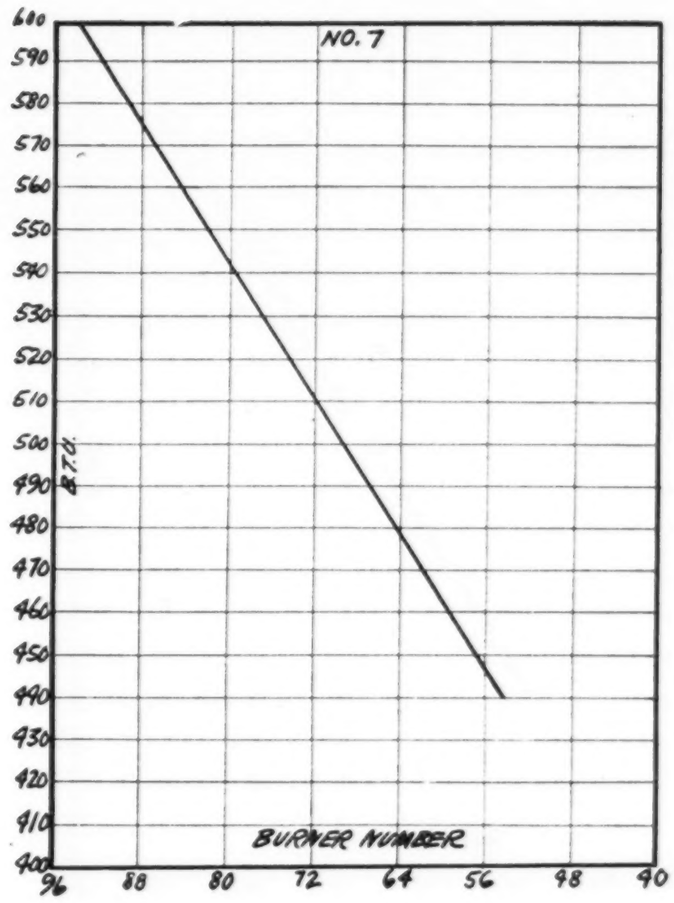


Fig. 7. Rochester burner numbers for 440-Btu carburetted water gas plus butane.

In fitting the dial to the air shutter the initial adjustment was made so that the dial reading would be 100 with an inner cone height of 1 inch. The dial was then soldered to the air shutter to insure that all future readings would be comparable on this same basis.

Required Limits

The limits which have been determined as necessary for a gas to give satisfactory combustion characteristics when used on the appliances connected to our lines, are as follows:

The burner number may vary between 92 and 110. Optimum conditions actually exist with burner numbers of 98 to 105. When readings fall below 92 there is a sharp increase in customer complaints due to noisy extinction, flashbacks, and pilot outages.

Burner number readings extending above 110 do not produce as rapid a customer reaction as the low readings just mentioned, but a noticeable increase in refrigerator complaints occurs due to "carbon"stopped flues and accompanying complaints. This latter complaint is actually caused by the refrigerator flues being partially stopped up with corrosion products. This restriction, however, has not reached the point where the normal flame will give trouble. But with the soft flame indicated by burner numbers above 110, carbon is deposited.

It was obvious that the burning characteristics of our gas in the winter

[1]AGA Proceedings, 1940.

The author, chief chemist for Boston Consolidated Gas Co., presented this paper before the Operating Division of the New England Gas Assn., Jan. 15 at Boston.

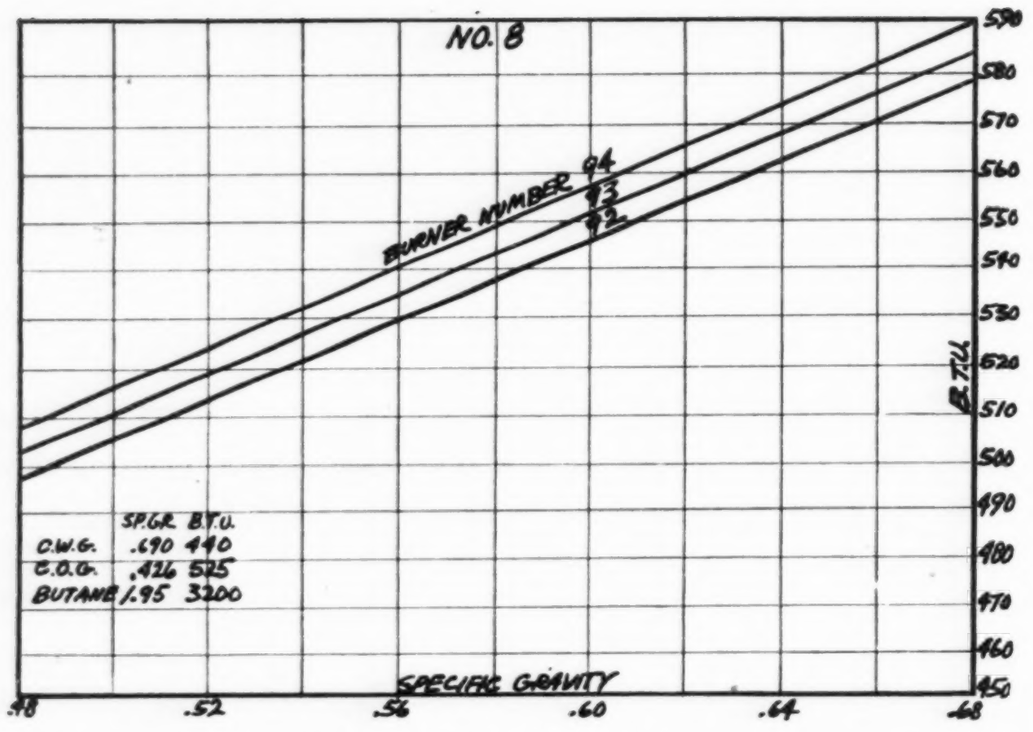


Fig. 8. Specific gravity-Btu relationship of coke oven-carburetted water gas plus butane to maintain Rochester burner number of 92-94.

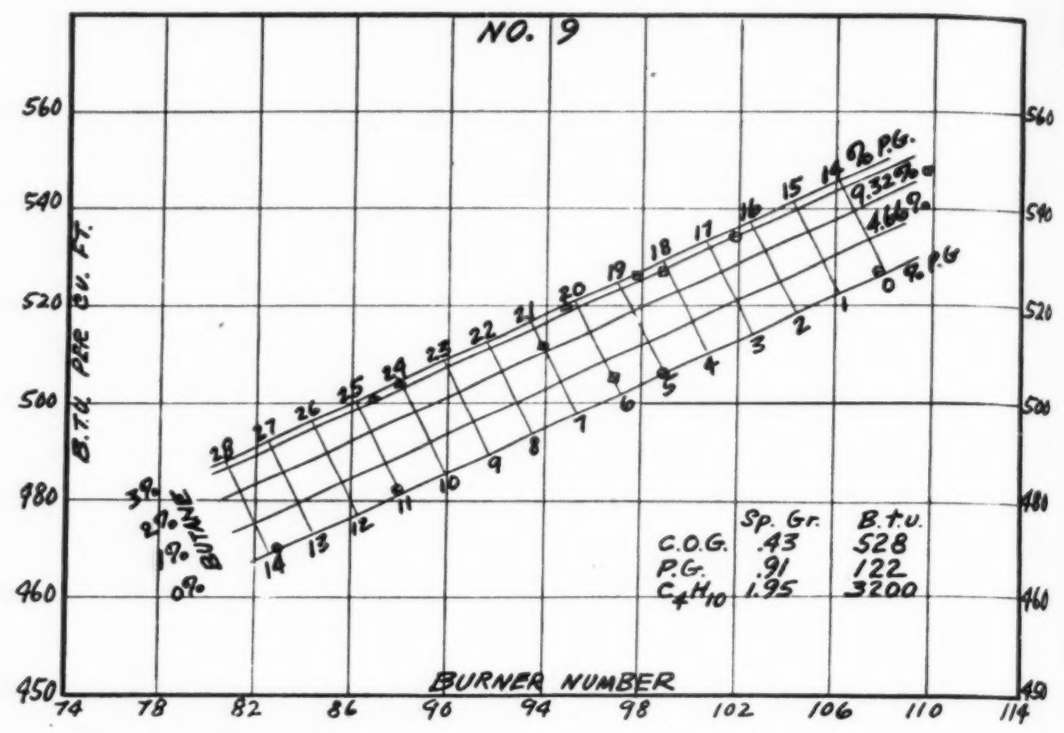


Fig. 9. Coke oven gas-producer gas cold enriched with butane.

months had changed, and the test burner data in *Table 1* will show the trend.

The data shown in the last column indicate a fast burning mixture which on our appliances at that time would give noisy operation with frequent flashbacks.

The soft coal strike of March-April, 1946, caused curtailment of our coke oven gas and we obtained further data on gas which caused customer complaints *(Table 2)*. At this time our new propane plant was nearing completion so at the end of this strike period we also had some propane-air in our sendout gas.

In comparing the above data it should be noted that in using propane-air we were compensating for our increased specific gravity by raising the heating value 4 Btu for each .01 increase in specific gravity of the sendout gas. In either case the burner numbers are too low for good appliance operation and the flashback numbers indicate trouble from noisy burner operation and flashbacks. It should be appreciated, however, that our complaints would have been much higher if we had not had the propane-air available.

Propane Enrichment

When load conditions permitted, the use of propane-air was omitted and the propane vapor was used for cold enrichment. A marked improvement resulted in the burning characteristics of our sendout gas *(Table 3)*.

It is true, however, that this improvement in burning characteristics has been obtained at a high cost and a 1% reduction in the sendout for each 5 Btu above 530.

A program was instituted where in the summer time, specific gravity was maintained—by the use of LP-Gas-air—from falling below .45, and the appliances serviced and sold were adjusted to give normal flames on 530 Btu, .50 specific gravity. This work has progressed slowly due to interference of other problems which occur in the extremely hot weather or fall starting-up periods, but nevertheless the effect has been appreciable.

This past fall possible curtailment of our coke oven supply seemed imminent and it was desirable to find out just how far we could raise the specific gravity using 530-Btu, .71-specific gravity carburetted water gas to supplement the 530-Btu, .43-specific gravity coke oven gas. This information was needed on short notice and the test burner offered the only satisfactory solution available to us. By setting this burner up in the calorimeter room the two gases with their respective recorders for Btu and specific gravity were available.

A word of caution is necessary relative to the interpretation placed on the graphs as shown. The burner number is taken as the operating guide and has been correlated with the corresponding Btu and specific gravities of the various gases used. However the burner number alone cannot be used to distinguish or set the limit of interchangeability for contemplated gases with the base adjustment gas.

The complete information given by the yellow tip number, burner number, and either the flashback or blowoff number, as determined on the test burner, offer the best guide now available for the plant operator, provided he has already obtained test data on the base adjustment gas and determined the tolerance of the appliances operating on the lines.

Fig. 1 was made from data obtained on 60% COG-40% CWG, 50% CWG-50% COG, and 40% COG-60% CWG mixtures. This shows that a burner number of 92 is reached when 33.5% carburetted water gas has been added in the CWG-COG mixture. Ninety-two has been determined, from a customer complaint correlation with test burner data, to be an operating minimum, as even in this case complaints can be expected to rise 60% above normal if gas is maintained at this quality for several days.

Gravity Curve

As the test burner number means very little to the man who must control operations by means of the heating value and specific gravity, a specific gravity curve was included.

Having determined from *Fig. 1* that compensation would be necessary to maintain a minimum burner number of 92 when the specific gravity rises above .53, tests were made to determine the rate of compensation required when butane is used for cold enrichment. At this time, test burner data were also

TABLE 1. TEST BURNER RESULTS—WINTER MONTHS

	7-10-45	12-6-45	12-14-45	12-13-45
Btu	529	535	529	532
Sp. Gr.	.377	.418	.441	.476
YT	52	52	54	51
B	100	87	83	79
FB	147	142	135	125
Coke Oven Gas	100%	89.5%	75.6%	75.2%
Carb. Water Gas		10.5%	24.4%	24.8%

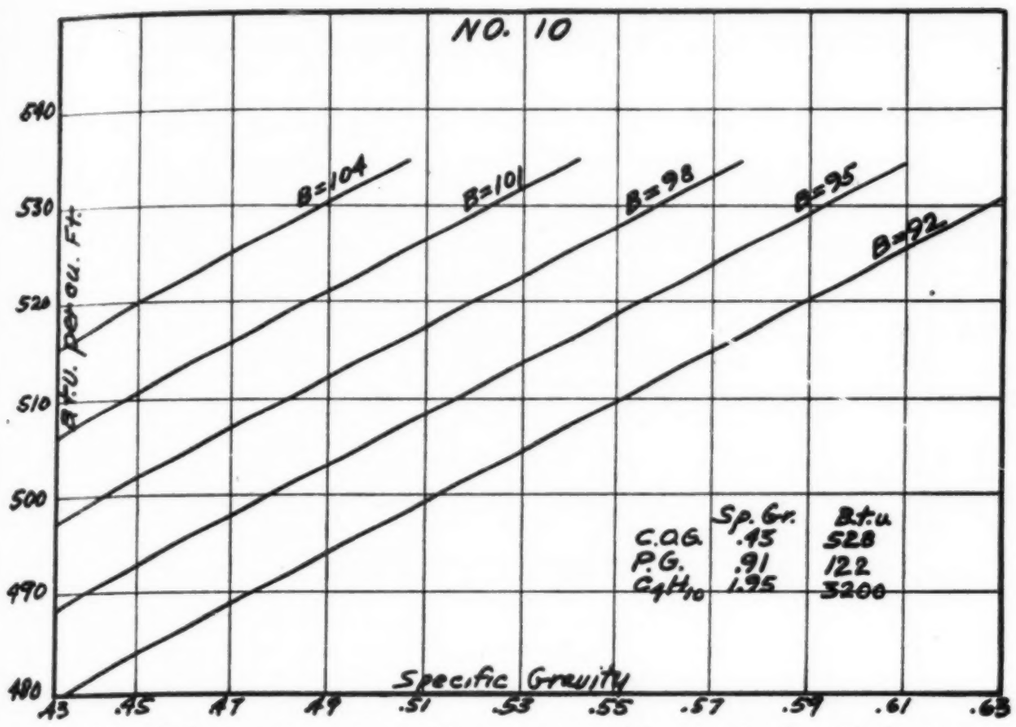


Fig. 10. Coke oven gas-producer gas cold enriched with butane.

TABLES 2 AND 3

	4-1-46	4-6-46
Btu	538	560
Sp. Gr.	.501	.523
YT	53	59
B	83	87
FB FB	138	130
Coke Oven Gas	66.1%	71.5%
Carb. Water Gas	33.9%	33.5%
880 Btu Propane-Air		6.7%

	5-20-46	5-28-46
Btu	567	570
Sp. Gr.	.530	.547
YT	72	73
B	110	110
FB	171	176
Coke Oven Gas	58.6%	64.2%
Carb. Water Gas	39.8%	33.5%
Propane Vapor	1.3%	2.3%
Still Gas (1500 Btu)	0.5%	

obtained for the cold enrichment of carburetted water gas as shown on *Fig. 2.*

Fig. 3, plotted from data obtained by cold enriching COG-CWG mixtures with butane, shows that 4 Btu are required to compensate for each .01 specific gravity increase if a burner number of 92 is desired.

Test burner data obtained on various butane air mixtures are shown on *Fig. 4.* It will be interesting to note that 530-Btu butane-air has a burner number of 64 showing that it acts as a very fast burning gas on the usual blue flame burners. From this curve it is possible to pick the heating value of the butane-air mixture which will give the desired burner number. In our case a 760-Btu mixture of butane air would be the minimum desired for a 92 burner number.

With *Figs. 3 and 5* the operator has a direct guide for the proper Btu versus specific gravity relationship to aid him in the use of butane—for cold enrichment—and butane-air.

The preceding method of operation permits the operator to hew as close to the line as possible and still keep customer complaints within reasonable limits.

Complaints Reduced

Circumstances regarding the production of coke oven gas and carburetted water gas made it possible to operate with a 525-Btu, .426-specific gravity COG and 440 Btu, .69-specific gravity CWG, cold enriching with butane back to 530 Btu for the sendout gas mixture. The unusually mild winter weather which lasted for several weeks kept the sendout down to the point where only 530-Btu gas was necessary, due to .53 specific gravity or lower. The daily test burner data showed burner numbers ranging from 98-100 and the customer complaints came down to what is considered a minimum from past experience.

Not only did the total complaints level off at a minimum, but the leak complaints, included in this total, showed a vast reduction. Leak complaints to the service department are of major importance because they must be handled on an emergency basis at the expense of other service work. In this case, the reduction of the CWG heating value from 530 Btu down to 440 Btu was made by cutting back on the oil used per Mcf, which was all added at the gasifier. With the sendout gas containing comparatively high proportions of this type of cold enriched water gas, the leak complaints remained far below the number previously received earlier in the season when lower percentages of 530-Btu carburetted water gas were in the sendout. To the service men there was a marked reduction in odor normally encountered with the winter sendout gas which is definitely tied in with the introduction of CWG.

November Results

This type of operation of the water gas sets continued for the month of November so that the improvement indicated by the low leak complaint record was definitely maintained over this period of a month.

Later it became necessary to increase the CWG Btu to 470-492, which resulted in the leak complaints increasing to a somewhat higher level but still showing considerable improvement over the record obtained with the present 510-520-Btu CWG operation.

Tests were made to determine the amount of 440-Btu, .69-specific gravity CWG which could be mixed with 525-Btu, .426-specific gravity COG before the burner number fell below 92. The results showed that 23% of this low-Btu CWG could be combined with 77% of the 525-Btu COG for the 92 burner number, as indicated on *Fig. 6. Fig. 7* shows the Btu-burner number relationship for 440-Btu carburetted water gas cold enriched with butane. Additional test burner data obtained using these two gases plus butane for cold enrichment permitted making the graph shown on *Fig. 8.*

This latter curve indicated that increased proportions of 440-Btu, .690-specific gravity CWG could be used before it would be necessary to raise the Btu with butane above the 530 value required for distribution. Thus the starting point for thermal compensation had been raised from .53 to .56. This amounts to a 12-Btu per cu ft reduction on the basis of 4 Btu per .01 increase in specific gravity for thermal compensation.

Butane-Enriched Gas

In order to take advantage of the possibilities indicated for the use of producer gas-butane, as a supplemental gas with coke oven gas, test burner data were obtained using 122-Btu, .91 specific gravity producer gas with butane vapor for cold enrichment.

Fig. 10 shows the curve, "Coke Oven Gas-Producer Gas Cold-Enriched with Butane," which permits one to determine the volume of producer gas that may be added to the normal 528-Btu, .43-specific gravity coke oven gas which, when cold enriched with butane, will give the desired burner number at 530 Btu on the finished gas mixture.

To put this information in the form that can be used by the operator, the graph shown in *Fig. 10* was made, showing lines of constant burner numbers plotted with the Btu versus specific gravity.

Elements of STATIC ELECTRICITY

By SIDNEY K. GALLY

From the time when our most remote ancestor was frightened by a bolt of lightning, static electricity has been a part of mankind's life and culture. The Greeks, over 2500 years ago, were aware that certain substances could be electrified, but it was not until the 17th and 18th centuries that static electricity was investigated scientifically.

This long awareness of the existence of static electricity has not produced in the mind of the average person an especially clear idea of its nature. A recent article in a popular magazine quoted a New York taxi driver who blamed the shocks he received from his cab on the passengers—"It's this worrying about the future that does it —builds up a heavy charge under the skin."[1]

Most people interested in safety in the gas industry have a somewhat better understanding of the subject, but it may be of value to review the elements of static electricity as they affect our industry.

STATIC electricity cannot be seen, of course, but is detected by the forces it exerts, the shocks it produces, and the sparks it creates.

The forces exerted are of little interest to us from the standpoint of safety, but to those industries which handle light materials, such as cellophane, they may be severely annoying because of the attraction of the charged material for other objects. The electrostatic forces have their valuable aspects; for example, several new printing processes are based on their use.[2,3]

The shocks caused by static electricity are more of a nuisance than a hazard. Although deaths to persons with weak hearts have been reported,[1] a more likely casualty might be caused by involuntary recoil from a shock.

The spark of discharging static electricity is its manifestation most dangerous to the gas industry. The danger lies in the ability of such a spark to ignite combustible or explosive atmospheres. Fortunately for the gas industry, the hazard, while existing under certain conditions, is not the continual source of fire it is in some industries and can be almost completely eliminated by the application of precautionary measures.

Electric Charges

All matter is believed to be made up of discrete particles, some uncharged, some said to be charged positively and some said to be charged negatively. When brought near a positive charge, a negative charge tends to attract it to itself. A negative charge in the vicinity of another negative charge would tend to repel instead of attract it. The converse effects hold for positive charges. An uncharged or neutral particle would neither be attracted nor repelled by charged particles and two uncharged particles would exert no electrical force on each other.

The gold leaf electroscope, a simple and effective device for detecting the presence of static electricity, operates because of the force of repulsion between like charges. One form of the electroscope consists of two pieces of gold leaf suspended from a metal rod. When electric charges appear on the gold leaf, the force of repulsion between the charges moves the leaves out away from each other to an angle where the force of gravity just balances the electrostatic force.

The smallest charged particle is the electron, which consists of one negative charge. Each atom of matter is made up of a swarm of these electrons revolving about a positively charged central nucleus at a relatively great distance. The number of negatively charged electron "satellites" is exactly equal to the number of positive charges in the nucleus, so that the atom as a whole is neutral or uncharged.

Electrons, being light and far from the center of the atom, can, under the proper conditions, be dislodged. If an atom loses one electron, there will be more positive than negative charges and the atom will have a net positive charge. The same applies to an object consisting of uncountable atoms; if some electrons are removed from one uncharged body and are transferred to another, the former will then be charged positively, the latter negatively. This is the essence of the generation of static electricity—the abnormal division of electrons between different bodies or substances. The mechanisms by which this occurs will be discussed later.

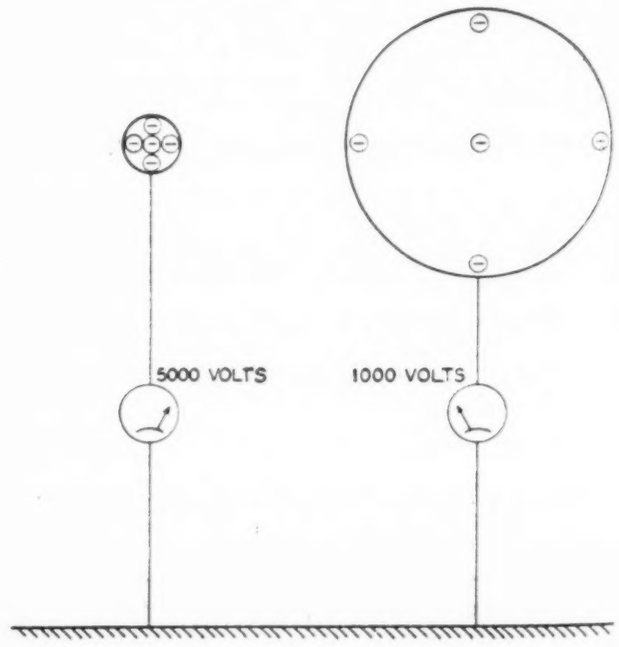
The charging of an object can be demonstrated by rubbing a piece of hard rubber with a wool cloth. Electrons will be transferred from the wool to the hard rubber. If either the cloth or the piece of hard rubber is brought near an electroscope, it will indicate that the object is charged.

Conduction

When electrons have been separated from positive charges, it is their nature to try to rejoin the positive charges, or in fact to join any positive charges or to flow to any large object such as the earth, which acts as an inexhaustible storehouse of charges. Certain substances permit electrons to flow through them easily and are called conductors. Typical materials of this classification are the metals, but from the static electricity viewpoint, such other substances as ordinary water are included. The dynamic form of electricity for which we are billed by the month consists of enormous numbers of electrons flowing continually through conductors.

The substances through which electrons flow with great difficulty are called insulators, the best insulators

Potential - - Capacitance



...t become a hazard in gas industry operations

being the waxes.[4] Air, liquid hydrocarbons, rubber and glass are also classed as insulators.

If positively and negatively charged objects are moved apart but are joined by a conducting path, the charges will flow together instantly. If the objects are insulated from each other and from earth, the charges cannot readily combine and may do so by means of a spark. Most methods of preventing the formation of static electricity are based on the provision of conducting paths over which the charges can flow.

Potential

When two charged objects, one being charged negatively and the other positively, are moved apart, a certain amount of mechanical work will be required because of the force of attraction between the charges of opposite sign. This work is not lost, but is stored as electrical energy.

The electrical potential is one of the elements which determines how much energy is in storage. Potential is measured in volts, the same unit which is used to designate a 110-volt lighting circuit. However, potentials developed by static electricity may range to thousands of volts. The voltage tells how much work must be done to add more charges to a charged object. The potential is often compared to the pressure of water in a vessel and can be thought of as the electrical pressure.

This can be illustrated by the following fanciful example which is in some respects similar to the actual accumulation of static electricity. Imagine a free balloon hovering in the air some distance above the earth, the balloon to be made of a fabric which will conduct electricity. The balloon will be uncharged, that is, it will have an exactly equal number of positive and negative charges. If an electroscope were brought near the balloon, the gold leaves would not move. The balloon will be at zero potential with respect to the earth and there will be no forces acting on any electric charges which are in the vicinity of the balloon.

Now, let the cooperation of a small bird be enlisted to charge the balloon. He will pick up a load of electrons from a supply on the earth and will fly up to the balloon and deposit them on its surface. The electrons will spread evenly over the surface of the balloon since they will repel each other and try to get as far apart as possible. If the electroscope is again placed near the balloon, the gold leaves will diverge. The balloon will be negatively charged.

Now let the bird again make a round trip to the earth for another supply of electrons. This time as he approaches the balloon, the electrons already on the balloon will repel those he is carrying and he will have to work harder than he did the first trip. If this process were repeated and repeated, each flight of the bird would become more difficult and following each trip, the electroscope would indicate more strongly. The electroscope could be calibrated in volts or a device called an electrostatic voltmeter could be connected between the balloon and the earth and would provide voltage readings directly. The work done by the bird does not disappear in heat, but is stored on the balloon as electrical energy and could be changed back into mechanical work by suitable devices. This balloon is represented diagrammatically on the left side of *Fig. 1*, where it is shown to be charged to a potential of 5000 volts.

Now let us imagine that the balloon, at a potential of 5000 volts, is inflated to five times its original diameter with no change in the number of charges on the balloon. The charges on the balloon, equal in number to those on the balloon before its size was increased, are still spread evenly over the surface but now are much farther apart. The electrostatic voltmeter would now read only 1000 volts. The expanded balloon is also shown in *Fig. 1*.

When the bird appears near the balloon again with another beak-load of electrons, he will find that the force tending to repel them is much less than it had been previously. He will discover that in order to bring the potential back to 5000 volts it will be necessary for him to make many more trips until the number of charges on the balloon is five times as great as the number after his first series to the unexpanded balloon.

This attribute of the balloon—or of any object—which requires a larger amount of charge to bring a large object to a given potential than it does a small one is called its capacitance. The capacitance of a body depends upon its size and shape, upon its distance from other objects, and upon the material separating them. The capacitance, plus the potential, tell one how much electrostatic energy is in storage. For example, when the balloon was charged to 5000 volts (assuming its capacitance to be 1000×10^{-12} farads) the energy could be calculated from the formula:

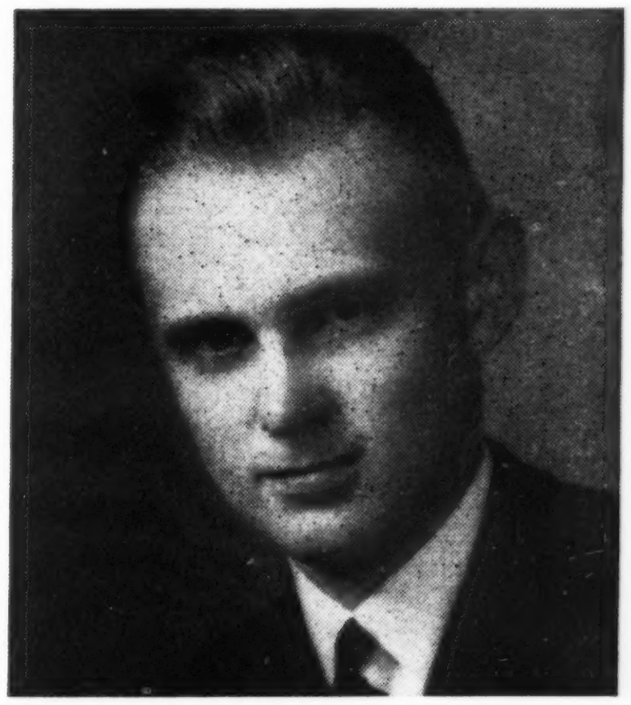
$$\text{Energy} = \tfrac{1}{2} \times (\text{Capacitance in farads}) \times (\text{Potential in volts})^2$$

and would be 0.0125 joule. It will be shown later how this type of calculation is of practical importance.

The question might arise in connection with the bird and the balloon as to whether the process could be continued indefinitely or whether there is a practical limit to the charge which the balloon could hold. There actually is a limit which comes about because of the failure of the air to continue to act as an insulator. The voltage or electrical pressure finally becomes so great at the surface of the balloon that electrons are dislodged from atoms of the gases in the air, leaving positively charged atoms to neutralize some of the elec-

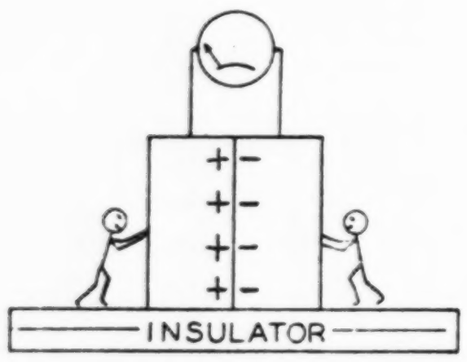
OF THE THREE manifestations of static electricity—the force it exerts, the shock it produces, and the spark it creates—only the latter is a potential danger to the gas industry. Fortunately, however, says the author, the hazard can be almost completely eliminated by the application of precautionary measures. Some of these are outlined in this paper, presented before the PCGA Accident Prevention meeting, San Francisco, Jan. 20-21.

Mr. Gally is intimate with electronic problems, having received a B.S. degree with E.E. major from Caltech in 1941, and following this with related activities. In 1941 and 1942 he worked on cathodic protection as technical assistant in the research department, Southern California Gas Co., Los Angeles. After a wartime tour of naval duty, serving as radar instructor and, later, as electronic officer on a destroyer squadron commander's staff, he returned to SoCal as engineering laboratory supervisor in the research department—his present position.

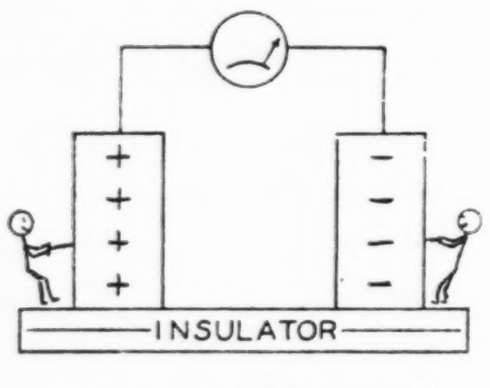


Sidney K. Gally

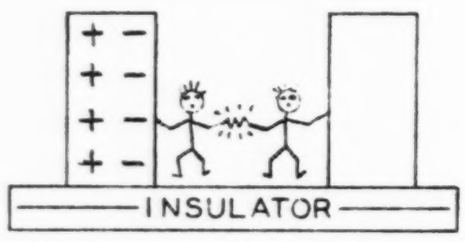
Forming a Spark



1. TWO DISSIMILAR MATERIALS IN CONTACT. ELECTRONS OF ONE MATERIAL MIGRATE ACROSS THE JUNCTION TO THE OTHER. LOW POTENTIAL BETWEEN THE MATERIALS.



2. MATERIALS ARE PHYSICALLY SEPARATED. MECHANICAL WORK DONE IS CONVERTED TO ELECTRICAL ENERGY. HIGH POTENTIAL DEVELOPED.



3. CHARGES RECOMBINE BY MEANS OF A SPARK WHEN GAP IS MADE SMALL. ENERGY IS RELEASED AS HEAT. SPARKS CAN ALSO JUMP TO GROUNDED OBJECTS.

trons on the balloon. This would appear as a small leakage current which would seem to carry charges away from the balloon as fast as they were added.

Another way for charges to get off the balloon would be to bring a grounded conductor near its surface. When the separation became sufficiently small, a spark would jump which would release the energy which had been accumulated on the balloon in a flash of light and heat.

Generation

The generation of static electricity does not create anything new; it merely requires the separation of existing electric charges. The first requirement in the process is that two substances, solid, liquid, or perhaps gas, be in contact. For reasons which are not too well understood, the electrons of one substance prefer to be associated with the other and a number of them migrate across the junction.[5] This does not happen only with peculiar materials such as cat's fur and amber, but with all materials to some extent. The effect is usually more apparent with those materials which are good insulators because the charges remain fixed where they can be detected.

The second requirement for the generation of static electricity is that the two substances be separated physically. If they are insulated from each other during the process of separation, the charges will remain divided and one material will be charged positively, the other negatively. The work expended in separating the materials will be converted to electrical energy and the potential between them, originally very low, will rise to a high value. These steps are pictured in *Fig. 2*.

Static electricity is also formed when a liquid is broken up into fine droplets or when a dust is suddenly dispersed. A separation of charge occurs, perhaps between large and small droplets or particles. Whatever the reason, the mist or the dust cloud may become highly electrified.

Fig. 2 shows a spark jumping between two charged objects after the gap in a conducting path between them had been made small enough. If the potential across a gap is below about 300 volts,[6] no spark will jump across the gap even if it is made very small. Thus, a definite figure is provided to evaluate the effectiveness of measures to prevent the accumulation of static electricity. If the potential cannot rise above this minimum sparking potential, then there is no danger of a spark forming.

Between sharp points, a potential of about 28,000 volts is required to jump a gap of 1 in. If the gap is formed between smooth objects of large radius, as much as 70,000 volts may be required to jump 1 in.[7]

Energy Requirements

The energy released by a spark is the principal factor which determines if it will ignite a combustible substance. The Bureau of Mines has made careful experiments to find the minimum spark energy which will ignite various explosive solids and vapor-air mixtures. They found that for such gases as methane, ethane and propane, the minimum energy which would cause ignition was between 0.0004 and 0.0005 joule.[8] In mechanical terms, this is about the energy required to lift a five-cent coin ½ in. Even allowing for a low efficiency in converting mechanical work to electrical energy, it can be seen how quickly a dangerous charge might be accumulated from a number of mechanical processes.

Bureau of Mines spark ignition tests were also made with high explosives. The ignition of powdered TNT, for example, required a spark with over 100 times the energy required by the gases mentioned above.[9]

The Bureau of Mines also measured the capacitance of a human being and found it to vary between 100 and 400 $\times$ 10^{-12} farads.[9] To find at what potential a charged human being could ignite a gas requiring an energy of say 0.0005 joules, the formula given earlier can be used. If the above capacitance values are inserted in the formula, the potential will turn out to be 1600 to 3200 volts depending on the value assumed for the capacitance. This may appear high, but in dry weather, sliding over an automobile seat or shuffling the feet on a carpet may charge a person to a much higher potential.

Eliminating Static

Static charges cannot accumulate on objects unless they are insulated from other objects and from earth. If a conducting path is provided between the objects so as to destroy the effect of the insulator, there will be no build up of charge. Objects which are so bonded together will be at the same potential and no spark can occur between them. If a bond connection is also provided to earth, then the objects will be at earth potential and will not spark to grounded objects. Bonding and grounding are often the only precautions required but it should be stressed that it is dangerous to connect a bond wire in the presence of a combustible vapor because of the possibility of a spark jumping to the end of the bond as the connection is being made.

Bonding and grounding can prevent the accumulation of charges on conductors but cannot drain the charges from an insulator. Nature demonstrates one method of discharging insulators when the relative humidity in the atmosphere is high. Under conditions of high humidity, a minute film of water is formed on the insulating surfaces and provides a conducting path to dissipate the charges harmlessly. When the relative humidity is low, this moisture film may be lacking with the result that the accumulation of static charges may develop dangerous potentials.

Fig. 3 shows the monthly distribution of fires in the rubber cement and coating industry which has frequent fires of static origin.[10] *Fig. 4* shows the minimum relative humidity for each month of the year 1947 in Los Angeles.[11] While the two curves do not apply to

the same region, it can be seen that the greatest number of fires occurred in the winter when the humidity was low while the least number occurred during the summer under conditions of higher humidity. In some hazardous locations where low humidity creates a problem, it is possible to increase it artificially by evaporating water to bring the relative humidity above 50 to 60%, which is considered fairly safe.

A third method of eliminating static electricity is accomplished by "ionizing" the air: that is, by breaking up some of the atoms of the air into positively and negatively charged particles. One method uses radioactive polonium which emits alpha rays that ionize the air in the immediate vicinity. Ionization may also be accomplished by flames and by sharp pointed wires.

Practical Sources

Any process in which liquid hydrocarbons are transferred from one container to another can generate static electricity. The contact between the liquid and the vessel causes positive and negative charges to separate in a manner similar to that shown in *Fig. 2*. The flow of liquid from a container leaves it charged with one polarity while the liquid carries away the charges of opposite polarity to perhaps another vessel where they may accumulate.

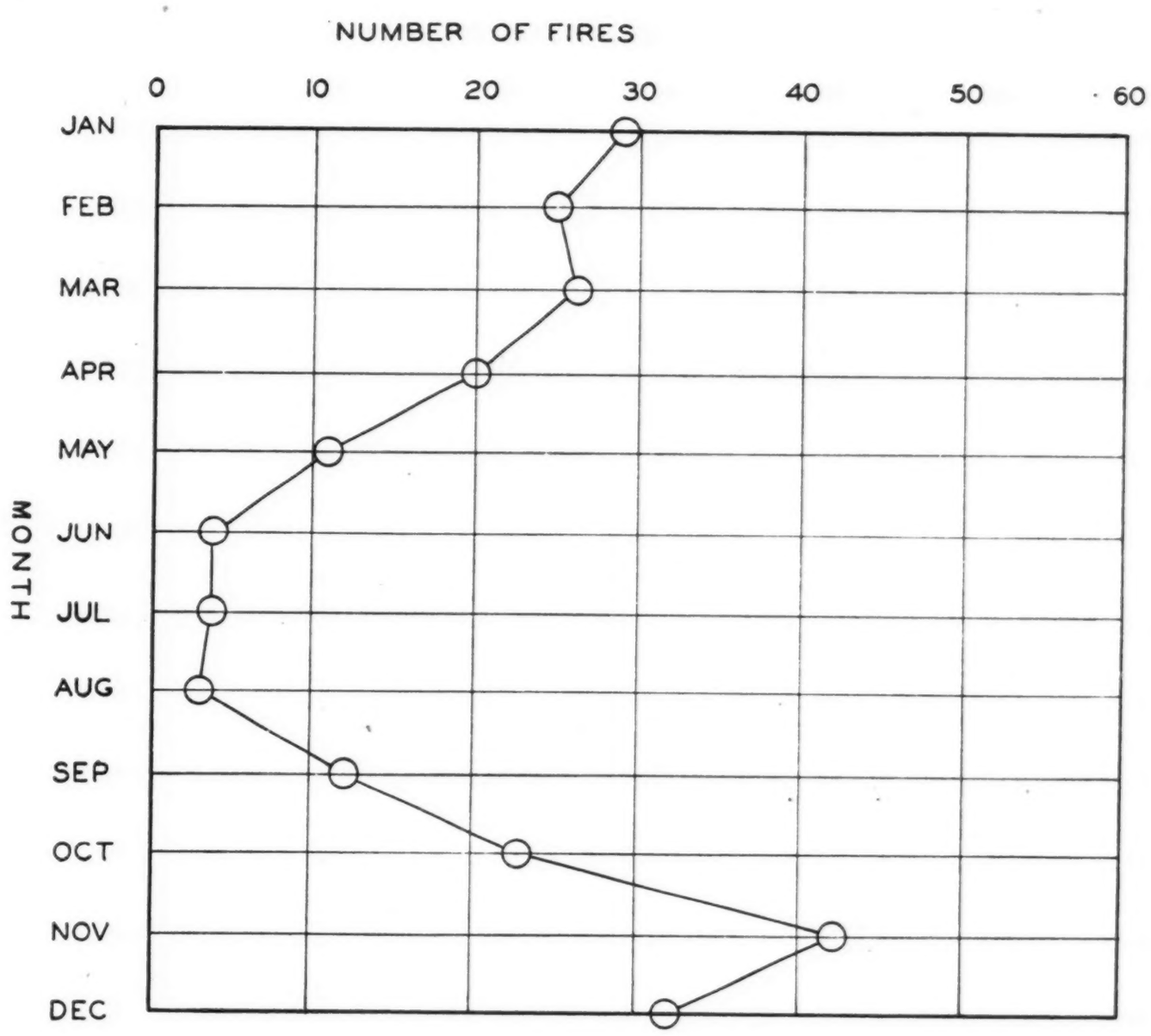
The process is continuous so that if one or more metallic objects in contact with the liquid were well insulated, its potential would rise until a spark jumped across the shortest available gap. In this manner, tanks, drums, funnels, fill pipes and nozzles have become highly charged. As in most static problems, it is not possible to get to the source and eliminate the division of electric charges; instead, they are permitted to recombine through a conductor or to drain off to earth harmlessly.

The obvious method of accomplishing this is to connect bond wires between all vessels, pipes and nozzles involved in the transfer of the liquid and then to run a grounding conductor to earth. These precautions are required by various state and municipal safety regulations which provide that the bonding connection shall be made before any containers are opened and shall not be removed until any hydrocarbon transfer is completed and the containers have been closed.[12,13]

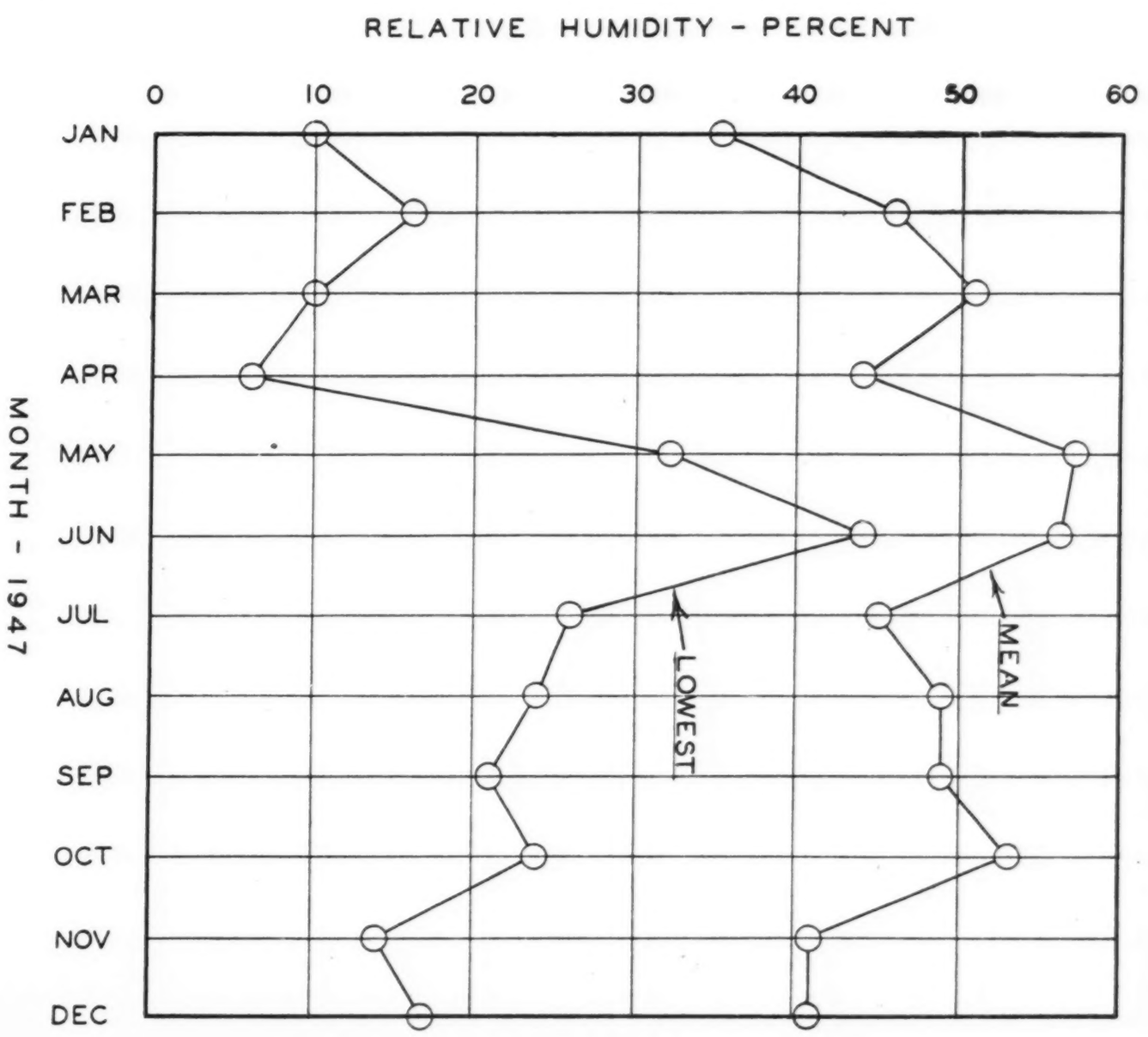
Dr. John M. Pearson in a recent paper has described the tremendous static potentials which are developed by air-agitated petroleum treating vessels and how the formerly frequent occurrence of fires has been eliminated by redesign of the agitators so that there was no free liquid surface and by use of mechanical instead of air agitation. Dr. Pearson also discussed the generation of static when large oil tanks are being filled by an incoming stream directed at high velocity against the liquid surface. He suggests that this hazard can be eliminated if the fill pipe is always beneath the surface of the liquid and directs its stream against the tank instead of the free liquid surfaces.[14]

Another common static generator is

Fire Distribution in Rubber Plants—1941-45



Noon Relative Humidity—Los Angeles



a moving automobile or truck. When the car rolls along the highway—most of which are excellent insulators by the way—the constant separation of the tire surface from the pavement causes charges to accumulate on the car body so that its potential may build up to very high values. Normally there is enough leakage to earth so that the charge drains off within a fraction of a second, but when the humidity is very low, the vehicle may remain charged for minutes after it has stopped.

It is a common experience in dry weather for the driver of a car to receive a noticeable shock when stepping from the vehicle. The capacitance of an automobile being roughly 500 x 10^{-12} farads and the potentials reached sometimes well above 10,000 volts, it can be seen that the available energy in a spark is far greater than the minimum required to ignite most combustible vapors. In the case of a passenger automobile driving into a filling station, if the charge does not rapidly leak off to ground through the tires, it will do so the moment the gasoline pump hose nozzle touches the car since the hoses used contain a built-in metallic bond which connects the nozzle to the pump and to earth. This also prevents a charge from being built up on the nozzle by the flowing gasoline.

In the case of a tank vehicle, there is more of a hazard because of the large amount of combustible material available and because of the higher capacitance of the vehicle, making for a hotter spark should one occur. The various regulations require that when dangerous products are being loaded or discharged from the tank vehicle, the tank be bonded to the loading rack and fill pipe before transfer of the liquid has commenced. This will discharge the vehicle before any combustible vapors are released.

Another precaution frequently required by law is that there be at all times a drag chain or conductor between the tank vehicle and the pavement. The value of this has been questioned both because of the fact that most pavements are such good insulators that the chain does not prevent the accumulation of charge on the vehicle and because of the possibility of the neglect of other precautions in the belief that the drag chain gives adequate security.[15]

A test was made recently with a tank truck which had a drag chain touching an asphalt paving. The truck was charged to a potential of 7000 volts and then was permitted to discharge through its tires and the drag chain. After three minutes, the potential was still above 2000 volts. The moral here is that one should never depend on the drag chain to discharge a tank vehicle.

Another practical source of static is in spraying and sandblasting operations. When a liquid is broken into fine droplets or when fine particles of a solid material are ejected from a nozzle, there occurs a charge separation which leaves the nozzle charged and also may charge any object upon which the droplets or the particles impinge. An example of this is the sandblasting process where, if a hose with a built-in conductor to ground the nozzle is not used, high potentials may develop on the nozzle.

This could be particularly dangerous when the inside of a tank or vessel which had contained a combustible material is being cleaned. Consequently, California requires that the nozzle of any device for cleaning or ventilating a vessel which might contain hazardous concentrations of vapors shall be electrically bonded to the shell of the vessel or tank. This applies to air ventilation, steam cleaning, sandblasting, or to any similar process. Steam is a potent static generator; in fact one of the first practical static generating machines developed for experimental purposes consisted of a steam jet.

It is occasionally necessary to vent gas from a high pressure main. The pipes sometimes contain appreciable quantities of fine dust, mainly oxides of iron. This dust can generate static just as can a sandblast hose, and the finer the dust is the more effective a generator it seems to become. If a man or other object were insulated from earth and at the same time in the path of the escaping dusty gas, a potential could build up on him until, when he brought some part of his body near a grounded object, a spark would jump and ignite the gas. Such an occurrence would be possible of course only under the combination of a number of circumstances such as low relative humidity, the presence of an insulating material between the man and the earth, and the presence of the man in the stream of dusty gas.

A convincing demonstration of the efficacy of this method of generating static electricity may be made as follows. On a day when the relative humidity is low, insulate a man from the floor by having him stand on a board supported by several blocks of wax. Then give him a small pair of hand bellows inside of which has been placed an ounce or so of jeweler's rouge, a finely powdered oxide of iron. Then let the subject pump the bellows vigorously for five seconds. If he has been well insulated from the floor, it will be possible to obtain a visible and tangible spark by touching him. To show that the spark has sufficient energy to be dangerous, the spark can light an acetylene torch or a gas burner.

Listed with the references are several articles and booklets which should be of value in solving problems caused by static electricity. Strict compliance with the legal safety requirements, although sometimes troublesome, is one of the best insurances against fires of static origin.

In spite of all precautions taken to prevent the accumulation of static electricity, or to drain it away harmlessly, fires have been known to occur. It is obvious then, that equally important with the elimination of the ignition source is the elimination of the combustible vapors from the region where a spark could occur.

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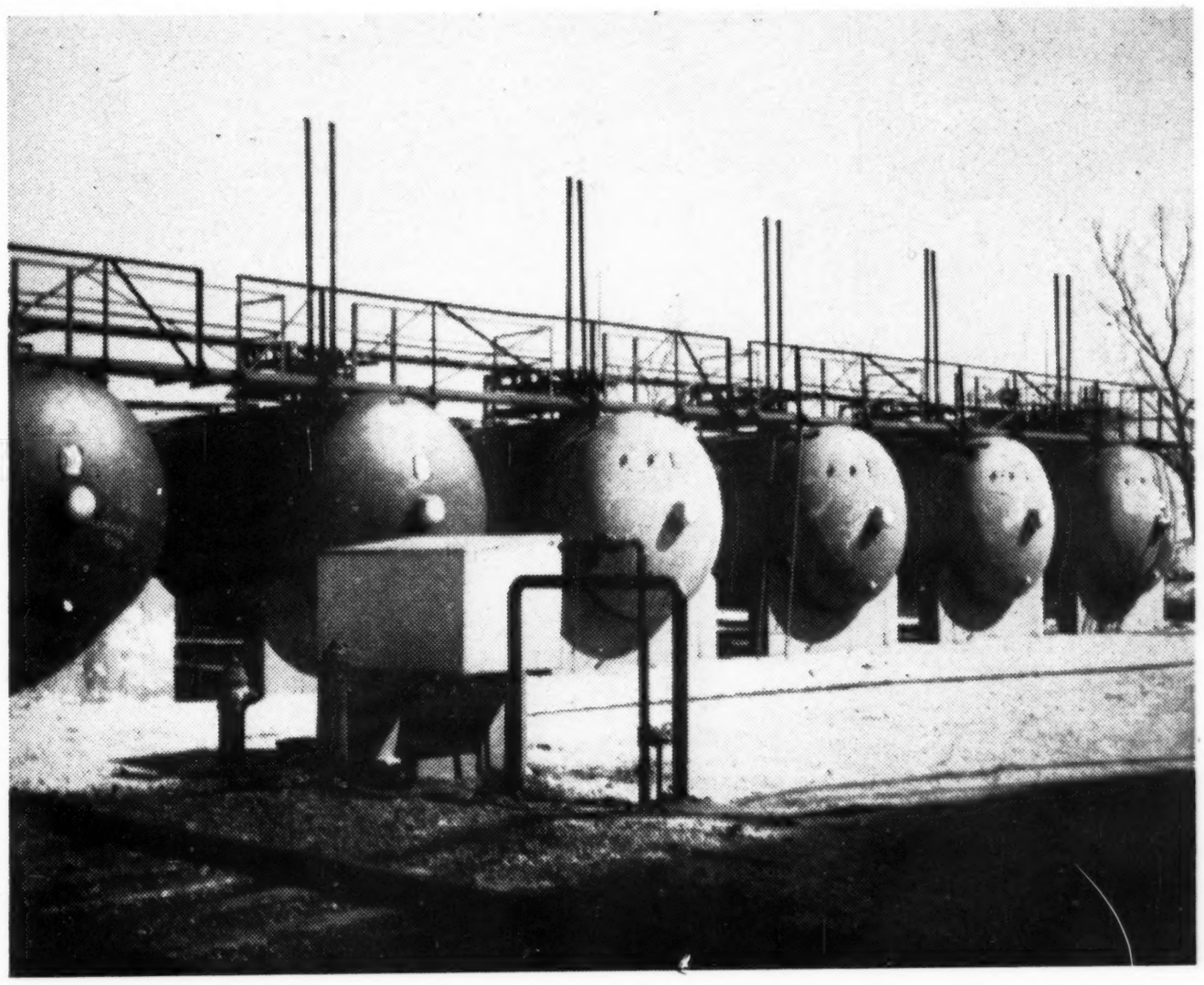


SIX 30,000-GAL. water capacity propane storage tanks stand ready to deliver standby fuel at the plant of the Kokomo (Ind.) Gas & Fuel Co.

Kokomo's Dual Standby Facilities Assure Good Winter Peak Service

By J. R. STROTHER

THE Kokomo Gas and Fuel Co., of Kokomo, Ind., is completing its second winter with its new propane-air standby facilities.

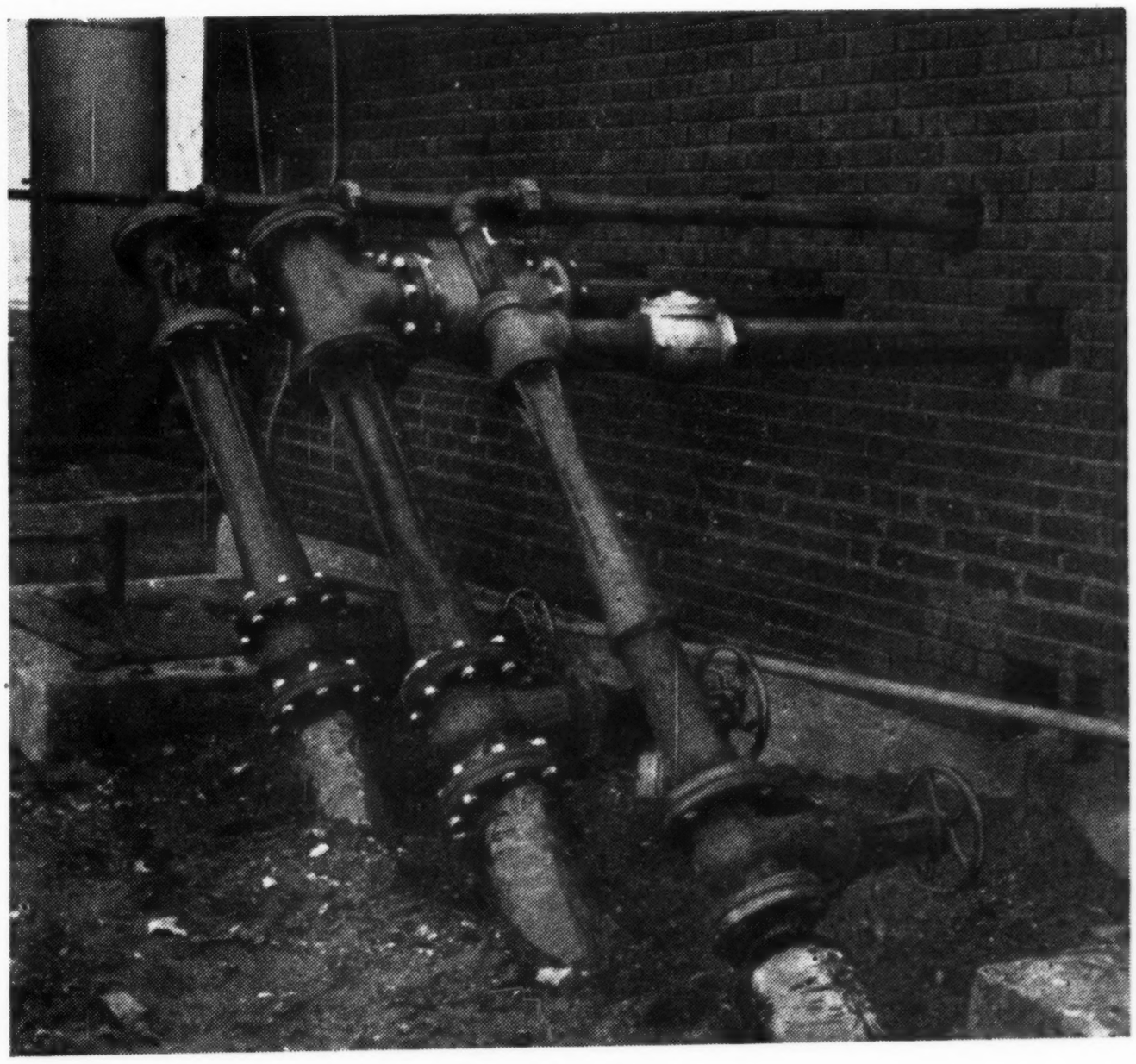
The installation, designed and engineered by Phillips Petroleum Co., with equipment purchased through them, was initiated in July of 1947 as a result of a growing need on the part of the utility to provide standby service to its existing natural gas facilities. Many delays were encountered during the installation of the new facilities, but the plant was operated for several days during the severe portion of last winter and in January of 1948 the plant was entirely complete.

The new propane gas storage facilities include six 30,000-gallon water capacity propane storage tanks with a tank car siding adjacent. Fuel is unloaded through a Brunner LP-Gas unloading unit. Liquid propane passes through an all-welded piping system from the storage tanks and is vaporized in four 13-in. diameter x 4-in. long multitubular heat exchangers; the vapor is regulated to 30 psi pressure through two 4-in. Reliance CBV regulators.

Gas-making facilities include a provision for the manual production of 1000-Btu propane-air gas to serve as standby and for peak shaving of 1000-Btu natural gas. The mixers consist of one 4-in. and two 6-in. Eclipse special injector assemblies having a combined rated capacity of 237,700 cu ft of 1000-Btu propane-air gas per hour. The output from the Eclipse injectors is fed to the inlet of an Ingersoll-Rand gas booster and provides gas main pressure of 15 to 20 psi.

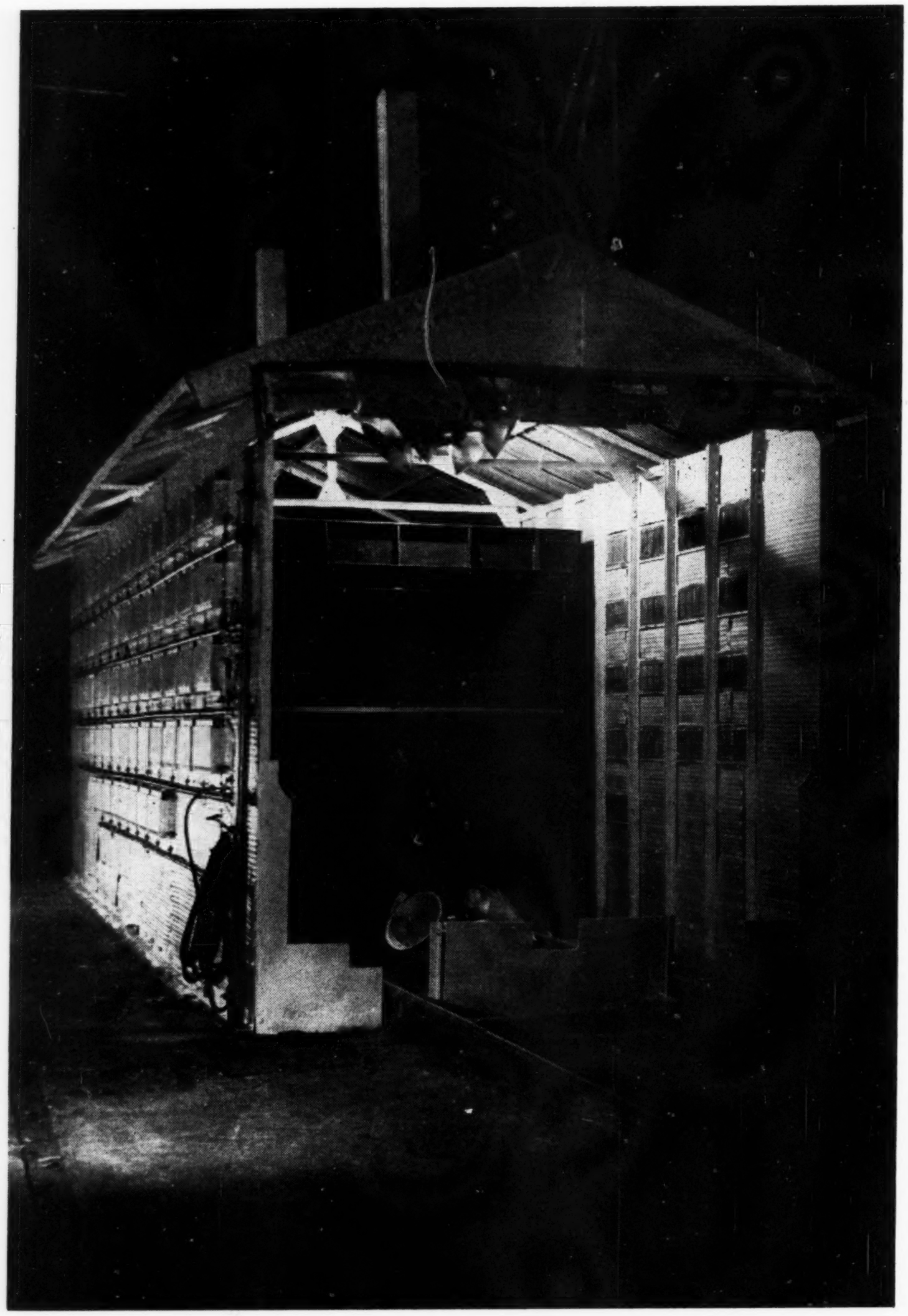
In addition to the new propane standby facilities, Kokomo maintains for emergency use its existing oil-gas producing facilities which have a capacity of 40,000 cu ft per hour. The plant also has 850 Mcf of natural gas holder storage available to customers of the Kokomo Gas and Fuel Co.

Mr. Strother is with the Philgas Division, Phillips Petroleum Co., Bartlesville, Okla.



INJECTOR ASSEMBLIES at the Kokomo standby. One of 4-in. capacity, the other two of 6-in., the assemblies can inject 237,700 cu ft of propane-air per hour.

Gas-fired Infrared Tunnel Cuts Drying Time



Reflectors at the top of the tunnel aid in keeping the heat inside.

A gas-fired radiant heated tunnel in a Scotland assemly plant has cut the drying time required for processing freshly-painted railway cars from a previous 30-to-70-hr period to an average of 12 hours. The actual heat processing period is only 15 minutes; the 12-hr period includes the first coat, switching the car, drying, cooling off, second coating, and the final drying and cooling off phases of the operation.

Exclusive

The plant, a Royal Ordnance Factory at Dalmuir, near Clydebank, contains the largest infrared drying tunnel of its type in Great Britain. The tunnel has 144 Potterton type (manufactured by Thomas Potterton, Heating Engineers, Ltd.) gas-fired infrared panels fitted on the sides of the 36 ft long, 10 ft 8 in. high structure.

British policy decisions some years ago determined a switch from wartime production to commercial output in this plant, with "waggon" assembly beginning in May, 1946. From the first, difficulty with the drying operations slowed production.

Precise data on the drying times before installation of the tunnel are difficult to determine, but a minimum of 30 hours with the original method of operation is fairly well established, and with unfavorable atmospheric conditions the period was extended to 70 hours or more. In such circumstances the speed of drying obviously controlled the extent of production, since no matter how fast assembly work was done the finishing was controlled by the natural drying factor.

Experimental work was carried out by a group of interested firms, including Heating Engineers; the cooperation resulted in the creation of the new unit. Actual installation was done by the Royal Ordnance management, with aid from the technical staff of the various firms.

Here's how the completed assembly line works:

The product is all metal, welded and riveted waggons of 7 ton, 10 cwt (the British long ton of 2240 lb) tare, suitable for coal, ore, or other heavy traffic. Manufactured components are received at the plant and are assembled on a long loop track line. The waggon is gradually worked, by overhead crane, diesel locomotives, or winches, to the end of the loop, where the first coat of paint is put on by hand.

The painted waggon is then switched to the tunnel line. The tunnel's length was determined by the fact that it had to be opened, with the area of radiation in excess of the size of the steel truck. As screens or doors were impracticable, the trucks themselves are used to block the ends of the tunnel. During the drying period the truck being worked is at the tunnel's center, with the front and rear of companion trucks blocking the open ends. Reflectors at the top of the open ends (see cut) throw back tunnel heat on the waggon ends.

As the truck enters the tunnel's center section, the line stops for 15 minutes, the actual drying time. With the adoption of suitable paints—air drying paints are now used—this period possibly might be halved. Each bank of panels is controlled separately, and graduated pressure is maintained on the several parts of the waggon by a governor. A booster is used, but pressure is not greatly increased. (Royal Ordnance is reluctant to part with any actual figures, but it *is* known that the

...ed Panels Dry Railroad Cars . . .

. . . CUTTING DRYING TIME BY 18 TO 50 HOURS

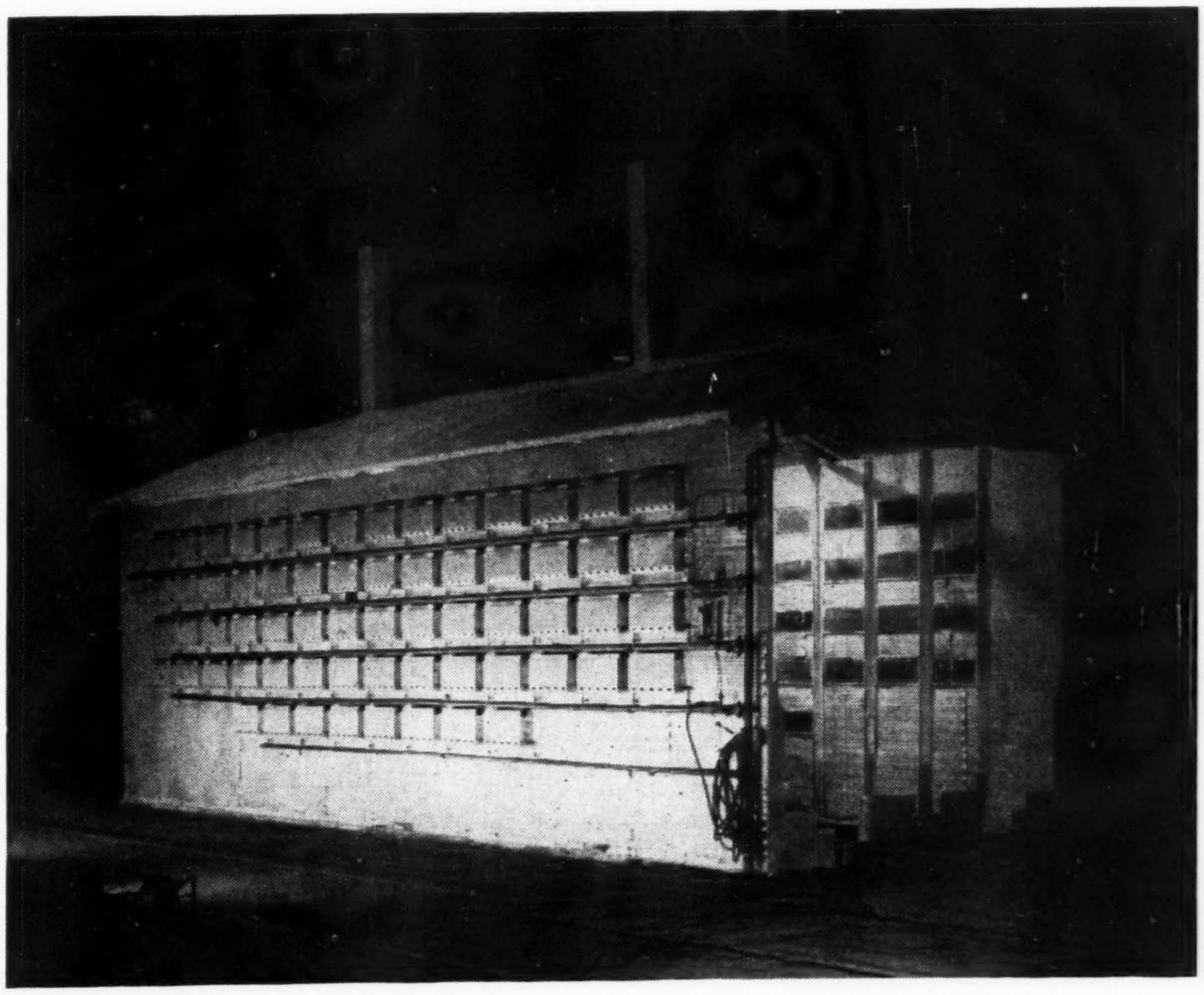
panel temperature is over 900° F.)

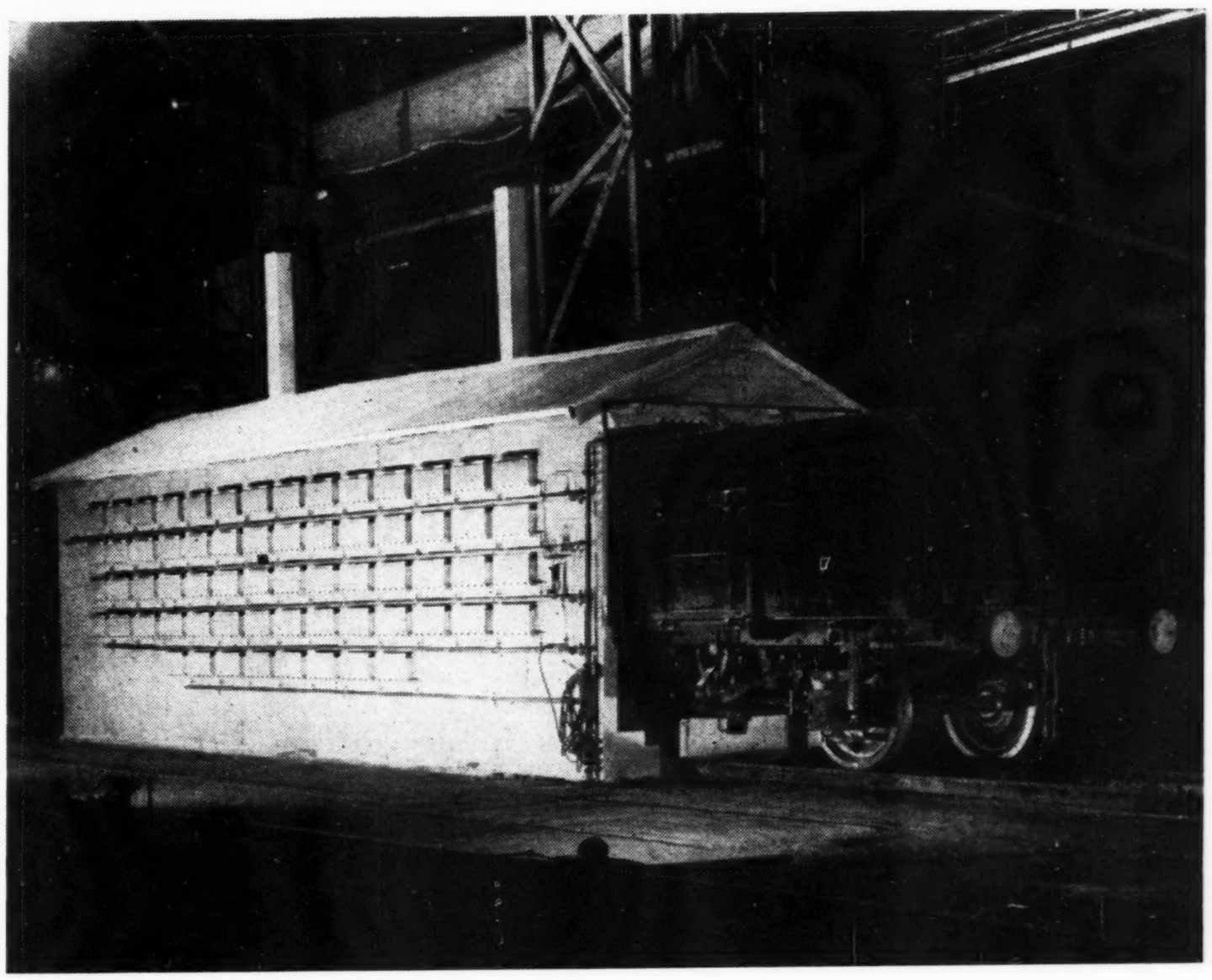
The truck, after drying, is switched to an adjacent line for return, and after a second coating and additional marking is returned to the tunnel. Inspection and official approval follow the second transit.

Radiation onto the lower part of the truck is set as high as practical, as heat loss upon the wheels is high through their contact with the rails. Paint used to cover the underside of the truck is bituminous in character. The sides, front, and back of the truck receive a red oxide paint.

Preliminary tests with models made up of the ½-in. steel plate used in the trucks were made in order to calculate the approximate flux density of the emitting surface. As the efficiency of the Potterton panel is around 40%, the combination of the panels and the tunnel's convected heat was sufficient to bring up the temperature rise to the necessary level.

Present output of the plant is about 70 waggons per week, or approximately 14 completed waggons per day. As these each receive two coatings, actual throughput is 28 waggons per day, each receiving 15 minutes heat processing. The drop from 30-70 hours to an average 12 hours for the complete treatment is held to be quite adequate but this time is not regarded now as final or even satisfactory. A number of factors could very certainly improve on this performance, primary among them being, of course, the experimenting with proper paints.





TOP PICTURE shows a "waggon" leaving the drying tunnel after infrared processing by the gas-fired panel heaters which line the tunnel's sides. Interiors of the waggons are not painted.

AT BOTTOM a car enters the drying tunnel. Previous to installation of the tunnel drying took from 30 to 70 hours, depending on the weather. The 12-hr average now in effect allows for two coats, separate dryings, and the car-switching and cooling-off phases of the operation.

Natural Frequencies of Compressed

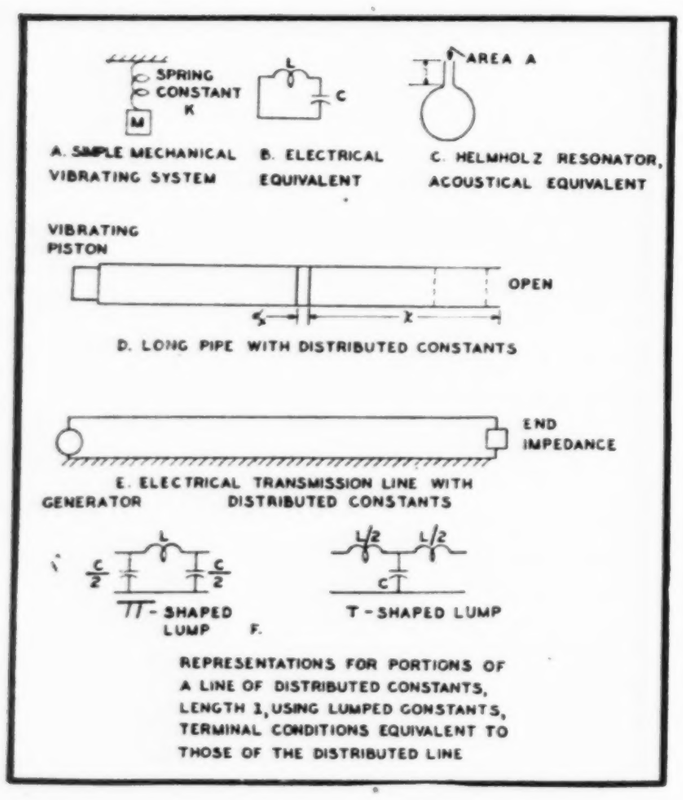

SPRING CONSTANT K
M
A. SIMPLE MECHANICAL VIBRATING SYSTEM
L
C
B. ELECTRICAL EQUIVALENT
AREA A
C. HELMHOLZ RESONATOR, ACOUSTICAL EQUIVALENT
VIBRATING PISTON
OPEN
D. LONG PIPE WITH DISTRIBUTED CONSTANTS
END IMPEDANCE
E. ELECTRICAL TRANSMISSION LINE WITH GENERATOR DISTRIBUTED CONSTANTS
L/2
C/2
π - SHAPED LUMP F.
T - SHAPED LUMP
REPRESENTATIONS FOR PORTIONS OF A LINE OF DISTRIBUTED CONSTANTS, LENGTH 1, USING LUMPED CONSTANTS, TERMINAL CONDITIONS EQUIVALENT TO THOSE OF THE DISTRIBUTED LINE

Fig. 1. Analagous systems.

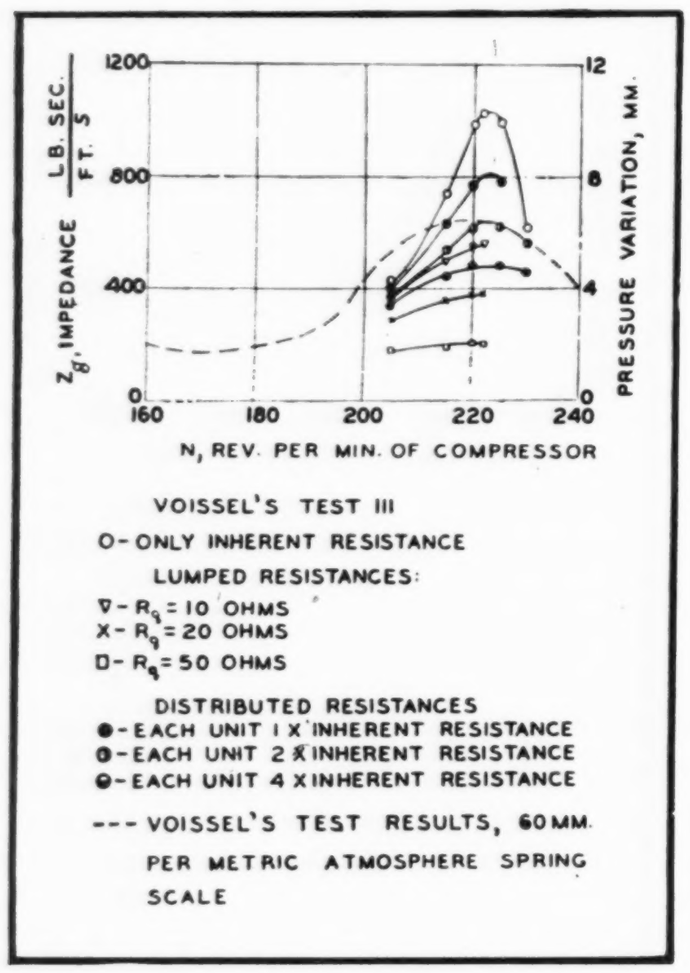


Fig. 2. Effect of resistance.

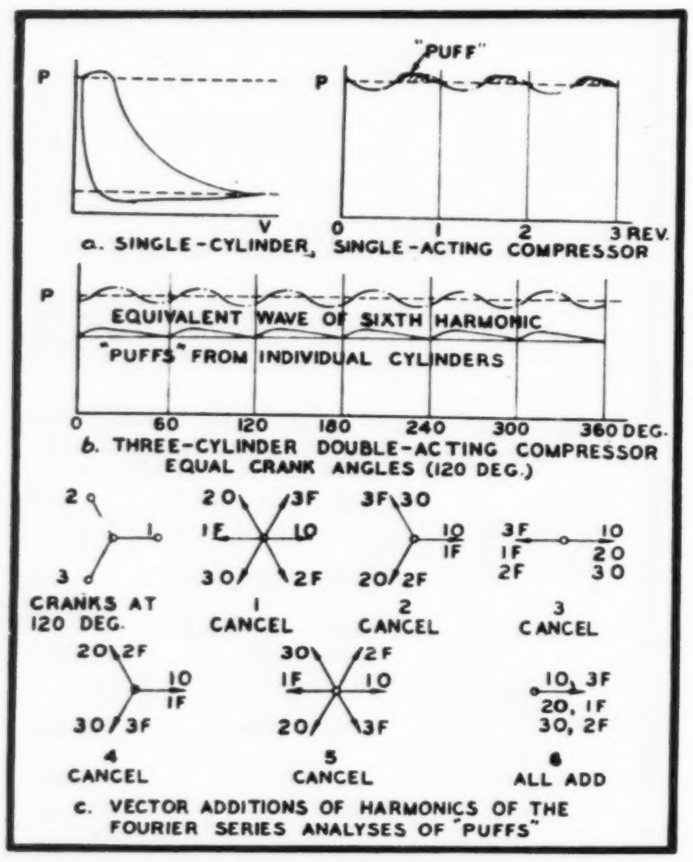


Fig. 3. Additions of components of pressure oscillation.

BUILDERS and operators of reciprocating compressors for many years have been disturbed by a number of difficulties. Some are noise, piping vibration, low or unexpectedly high capacity, low efficiency, or serious periodic vibrations in speed, called hunting. Attempts to correct these difficulties in completed plants are expensive.

Such disturbances appear to be due to resonance between the natural frequencies of the piping system or a portion of it and the fundamental or a harmonic of the pressure wave set up by intermittent intake or discharge of gas by the cylinder. Thus determination of the natural frequency of the piping system is necessary.

It will be recognized that these pressure pulsations within the piping may cause difficulties due to their effect upon the indicator cards or because of vibration of the piping itself as a Bourdon tube pressure gage and as a result of a change of momentum of the gas. It is emphasized that the *superimposed* oscillating component of pressure is studied, not the pressure drop due to steady flow through the system. An average pressure P_0 throughout the system is assumed.

Direct calculation is possible for simple piping systems from the usual organ pipe theory, but more complicated systems cannot readily be calculated in advance of construction. Because of the complexity of the typical compressor or engine plant piping system, the labor involved in mathematical calculation is often unwarranted. The effect of a simple change of some quantity such as manifold volume can only be determined by repeating the entire calculation. The analogy to torsional vibration or to water hammer is apparent but not directly applicable. A direct experimental attack on a small-scale model is possible but difficult.

Good indicator diagrams at speeds between 500 and 1500 rpm are rare. Measurement of the oscillating flow of gas is also difficult. The graphical method proposed by Warming[1] seems best adapted to quick solution of simple circuits but not to solution of complex circuits or especially to trial of many proposed alternatives on complex systems, since a nearly fresh start must be made for each trial and a separate diagram is needed for each branch of any complex piping system.

An electrical analogy method was originally suggested by Dean L. M. K. Boelter, now at the University of California at Los Angeles, as a convenience in visualizing the problem. Experimental use of radio capacitors, inductors, and an oscillator at audio or radio frequencies appeared possible. The difficulties of changing wiring, the relative scarcity of readily variable accurate capacitors and inductors, the relatively large impedances of the connecting lines, and the possibilities of interference made this direct attack seem impracticable. Installation of an A.C. network calculator by the Armour Research Foundation of Illinois Institute of Technology made direct experimentation seem feasible.

The electrical analogy seemed desirable as a direct attack on an electrical network calculator of the type used for solving alternating current transmission line problems. In contrast to direct experiment, the electrical method permitted simple, safe, and accurate measurement by a single observer of the electrical potential difference or voltage, the current, and other quantities in a stable and easily adjusted system of any complexity.

A given electrical circuit with definite numerical values actually represented a variety of acoustical systems, tending toward generalization of the problem. The use of an electrical analogy for an acoustical system is not original. Olson[2], for example, presents a number of analogies. The use of the A.C. network calculator for *direct* experimental attack seems new.

Any analogy between comparable systems depends upon the fact that behavior of each system is described by equations of the *same form*. The analogy used here depends upon substitution of electrical terms for the corresponding elements in differential equations derived for the acoustical system. The derivation made the usual assumptions of small pressure fluctua-

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The author, formerly with Ingersoll-Rand and assistant director for research, prosthetics and sensory aids service, Veterans Administration, presented this paper before the California Natural Gasoline Assn., Jan. 6, at Downey.

ssed Engine Manifolds

By DR. EUGENE F. MURPHY

tions from an average value, a continuous medium without shock waves, stiff and unyielding pipe walls, etc. The present analogy, as used experimentally, neglected the effect of resistance or damping upon the resonant frequency. Therefore, no attempt was made to predict actual pressure or velocity fluctuations.

The analogy between *lumped* mechanical, acoustical, and electrical systems is well known. The corresponding analogy in the case of a distributed system, while recognized, does not seem to have been used experimentally. *Fig. 1* shows three simple, idealized, lumped systems. Friction or resistance and driving forces are neglected in each case. The respective differential equations are well known. Derivations are briefly outlined in the appendix.

Several relationships are possible, but for convenience in visualizing the problem and in selecting the ranges of elements which are physically available, oscillating pressure (about an average pressure) has been replaced by alternating electric potential, and rate of oscillating gas flow or volume current by alternating electrical current. Then the inertia of the gas may be visualized as comparable to the inductance. The spring effect of a volume of gas (into which more may be packed by raising the pressure) is replaced by a condenser or capacitor, on which more electrical charge can be stored by raising the voltage.

Equations for long pipelines with distributed parameters or properties are derived in different ways in various text books on acoustics and in a thesis by Rheinhart.[3] The final equations for motion show the same values for inertance and capacitance when compared with the equations for electrical transmission lines with distributed inductance, capacitance to ground, and resistance.

Electrical texts then show that the uniformly distributed parameters can be replaced, so far as the effects at the terminals are concerned, by lumped or grouped parameters arranged in pi- or T-shapes as shown in *Fig. 1*. For the pi-shaped lump, all the inductance in the line segment considered is gathered into a single inductor. All the distributed capacitance to ground is replaced by two capacitors, each half of the total distributed capacitance, connected from either side of the inductor to ground. Alternatively, the T-shaped lump splits the total inductance but combines all the capacitance. The two

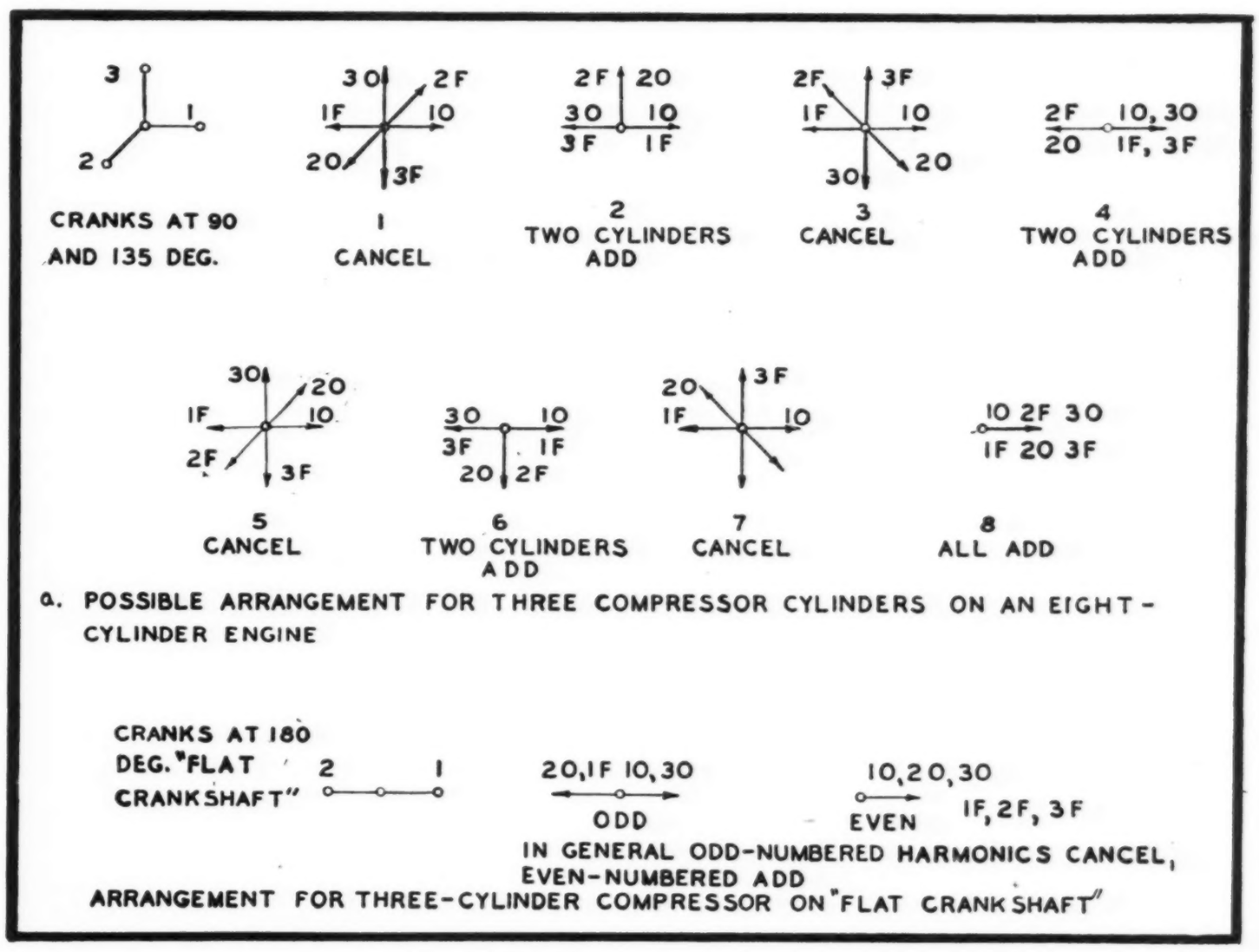

Fig. 4. Vector additions and other arrangements.

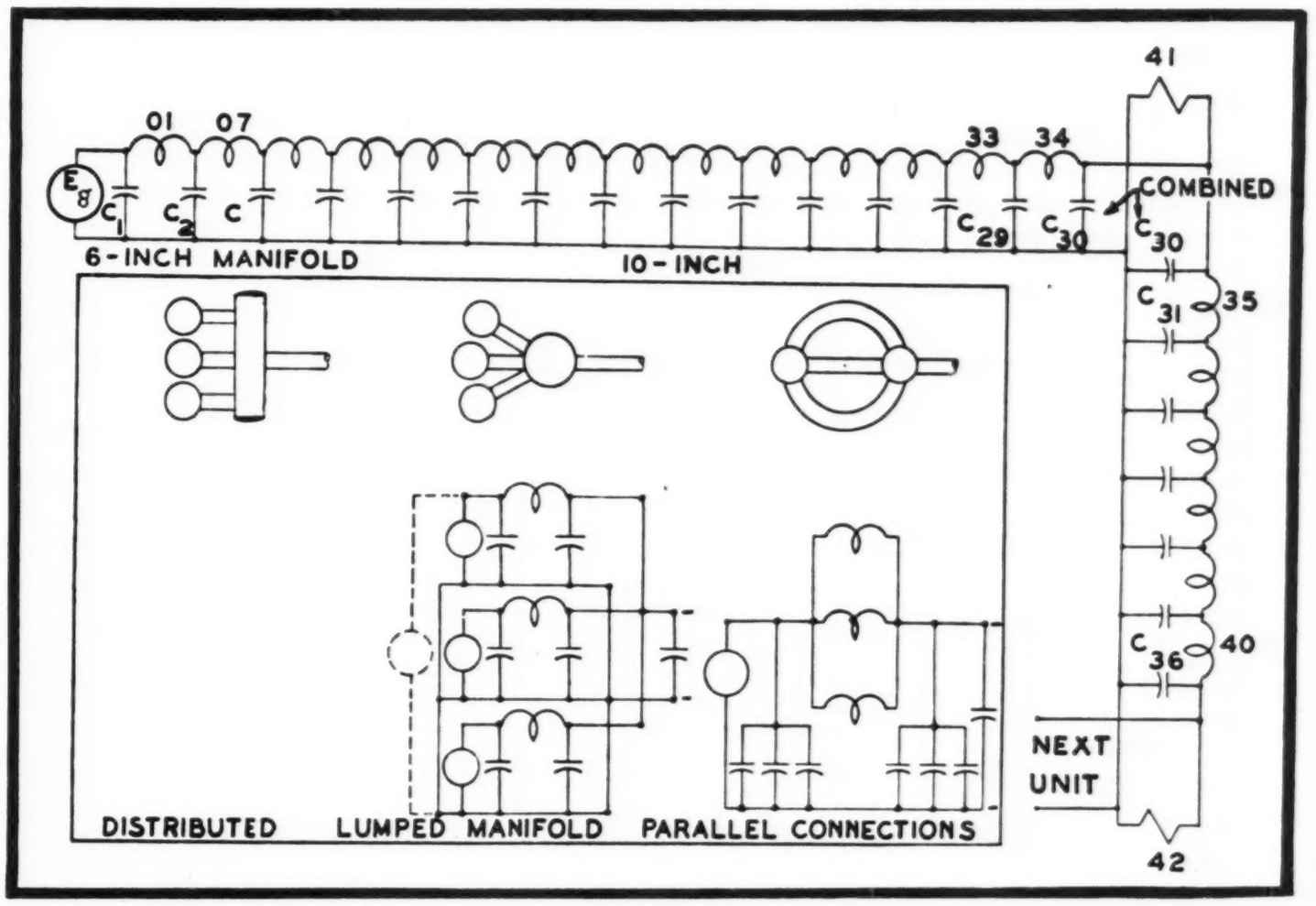

Fig. 5. Development of simplified wiring diagram, lumped manifold arrangement 14, three-cylinder natural gas compressor.

circuits are equivalent.

For adequate engineering accuracy the higher terms of the hyperbolic functions for the exact replacement can be neglected, provided the segment considered is less than 1/20th to 1/10th of a wave length at the frequency under consideration. Lumps 3 to 10 ft long are often suitable in dealing with engines or compressors.

A consideration of the boundary conditions for the lumps shows that adjacent segments of a plain cylindrical pipe can be joined end to end. The adjacent capacitors may then be added and combined into a single capacitor. A similar process can be carried out at changes of cross-section, as from a small pipe leading into a header.

Certain components of predominantly one type of parameter, either capacitance or inductance, can often be represented by single lumps or even combined with the adjoining lumps. The acoustical inertance, analogous to electrical inductance, varies inversely as the cross-sectional area of the pipe, while the acoustical (and analogous electrical) capacitance varies directly with that area. Thus short sections of large diameter as compared to the rest of the system, such as manifolds or receivers, are analogous to nearly pure capacitors. If the small inductance is neglected entirely, the pi-shaped lump can be simplified to a single large capacitor which in turn can be added to the capacitors of the adjoining pi-shaped lumps to form as a single still larger capacitor. The total number of electrical units needed on the calculator is thus reduced. In general as many capacitors as inductors are necessary.

An open pipe can be shown to correspond to an electrical short circuit, since pressure disturbances are immediately dissipated. At a capped or closed end the piping system is cut off, pressure can fluctuate, but no further disturbance is possible beyond that point. Correspondingly an open end of the electrical circuit, without connection between the line carrying the potential and the ground, prevents electrical current from flowing further but permits potential to exist between the line and ground and wave reflection.

An infinitely long line can be replaced by its "surge impedance" just as an infinitely long electrical transmission line. This impedance is a pure resistance connected from the line carrying the potential to the ground. No reflections will occur from such an impedance since it is equivalent to a line through which the disturbance passes indefinitely without returning.

In the calculations for most of the cases studied in the thesis and compared with practical experiments, resistance was neglected. A considerable number of cases, too numerous to report in detail here, included engine and compressor intake and discharge lines, some including surge chambers. The *natural frequencies* of the piping systems as determined by the electrical analogy coincided within 1 or 2% with those determined experimentally on the actual piping systems.

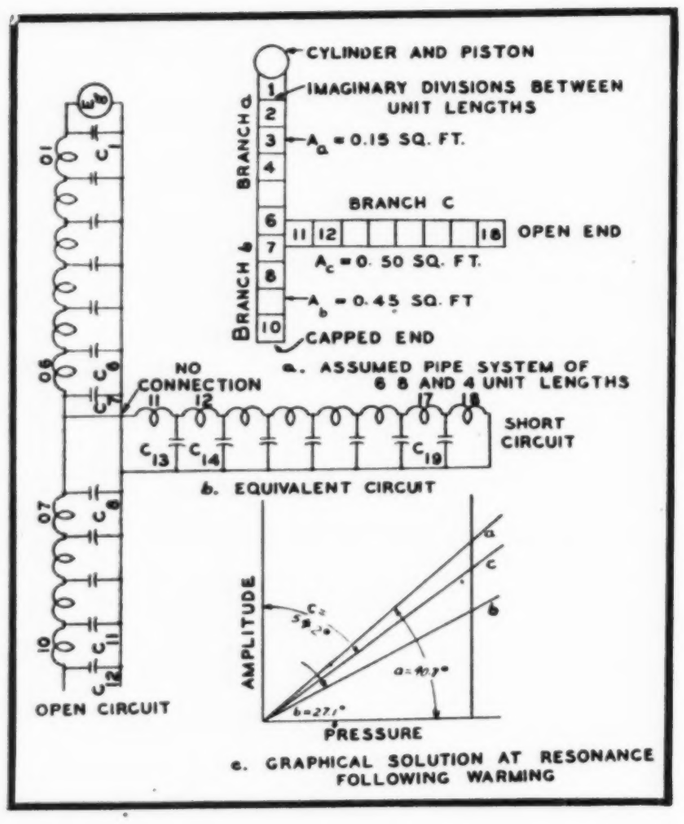

Fig. 6. Hypothetical T-shaped pipe.

To estimate, to a certain extent, the effect of resistance, electrical resistance was arbitrarily added in a circuit corresponding to *Test 3* on a compressor intake by Voissel.[4] It will immediately be recognized that acoustical pressure drop varies as the *square* of velocity, whereas the electrical voltage varies only *directly* as the electrical current. The analogy thus does not truly hold for resistance, if a simple resistance element is used. (Since the experimental work for this paper was conducted, several multiplier systems have been described by Harder and McCann.[5] Their use, however, does not seem necessary for *this* purpose since for natural frequencies such satisfactory agreement was obtained with the complete neglect of resistance. No attempt was made to predict extent of pressure or velocity variation.)

Addition of Resistance

As shown in *Fig. 2* the addition of resistance, either as a lump at one point in the electrical circuit corresponding to the piping system or distributed throughout the circuit, merely lowers and flattens the resonance curve with only a slight downward shift of the natural frequency. As a matter of fact, addition of considerable resistance makes the electrical resonance curve more nearly resemble that obtained on the practical acoustical system.

The following section may be unnecessary for those familiar with methods for predicting torsional vibrations of crank shafts, a comparable phenomenon.

A Fourier series analysis might be made of the resultant pressure disturbances due to the train of "puffs" of gas or air in the pipeline immediately adjacent to the machine. The relative magnitudes of the fundamental and the various harmonics of the irregular "puff" due to one end of one cylinder will depend on many factors, such as piston action, relation of sizes of valve, pipe, and cylinder, valve opening speed and pressure at that time, etc. Fortunately, knowledge of the exact wave shape is unnecessary.

As shown in *Fig. 3*, a crude picture may be obtained by considering the "puff" from the indicator card when it is replotted on a time basis.

If more than one cylinder end pumps into or from a given piping system, the appropriate harmonics can be added by vector diagrams, as in *Figs. 3* and *4*. The most serious disturbance will occur for resonance between the natural frequency in a given mode of vibration and a harmonic yielding the maximum vectorial sum of the harmonics of waves due to the "puffs" from the individual cylinders. Less serious and often negligible vibration will occur for resonance between a natural frequency and other harmonics which add to lower values.

Comparison of *Figs. 3* and *4* shows that the number of the harmonic whose vectors are parallel and in the same direction, and hence add directly, is *not* necessarily the sum of the number of cylinder ends. If the impulses are uniformly spaced, their sum equals the number of cylinder ends and indicates the number of the important harmonic. However, irregular firing orders or spacing of cylinders should be studied by means of the vector diagrams, as in *Fig. 4*. The relative importance of eight times the eighth harmonic compared to only twice the sixth harmonic for such a three-cylinder, double-acting machine will depend on the shape of the "puffs."

The engine crankshaft should be designed from this viewpoint as well as other considerations, such as firing order, stress, and torsional vibration. An estimate may often be obtained by superimposing arbitrary shapes of "puffs" from the cylinder in their proper timing and noting the frequency of the major ripple in the sum of the waves.

For the acoustical system the properties of the gas at an average pressure P_0 and temperature are presumed to be known. In the case of high pressure compressors the super-compressibility of the gas should be considered. The value for the ratio of specific heats

should also be obtained for the pressure and temperature which will actually be encountered. Acoustical inertance and capacitance for the various segments of pipeline can be readily calculated, preferably in tabular form.

Suitable sections or lumps are usually the length from cylinder to manifold, the complete manifold, and sections of 1/20th or even, with good accuracy, 1/10th of a wave length in the main discharge pipe. The wave length, of course, is that corresponding to the suspected harmonic of the operating speed of the compressor for which the vector diagram shows disturbance may occur.

The acoustical impedance Z_a is the pressure divided by the volume current in consistent units. The relationship between the acoustical and the electrical systems is then defined in terms of an arbitrarily chosen scale factor F_s.

For the particular calculator used, with an operating electrical frequency of 440 cycles per second, the inductive reactance was directly calibrated on the dial. The capacitors, however, are calibrated in micro-farads.

Combining Cylinders

The process of adding units is shown in *Fig. 5*. In the box are shown first a three-cylinder compressor discharging into a manifold, then the same system with the manifold considered as a lumped volume or sphere with three parallel cylinders discharging into it, then an equivalent single cylinder discharging through separate passages into this sphere. It will be recalled that under the critical conditions at which serious resonance will occur, usually all the harmonics are in phase, and therefore the cylinders act as though they were one, all pressure waves in phase.

The corresponding electrical networks are shown in the bottom of the box, although the very elaborate network corresponding to a distributed manifold is omitted because of lack of space. Around the top and right side of the box is shown the equivalent network. For a practical piping system the three parallel and equal inductors of the last circuit in the box are combined as a single inductor of value 1/3 of any one of the three. The three parallel capacitors are combined as a single capacitor—equal to the sum of the three. Then the capacitors on the right side of the first pi-shaped lump and the left of the next are added and combined.

The final result is an electrical system which looks as if it applied to a simple straight organ pipe. The numerical values of the first few units corresponding to the small pipes from cylinders to the manifold and to the manifold itself are not equal to the values for adjacent elements of plain pipe to the header.

This result indicates that a *generalized* system could readily be tested with systematic variation of the first few inductors and capacitors in comparison to the remainder to give the effect of variation in manifold size and volume. Some preliminary experiments of this nature were in fact performed very simply and rapidly.

The network calculator is operated at a constant frequency, say 440 cycles per second. The effect of varying acoustical frequency, corresponding to resonance with a new compressor speed, was obtained by varying the scale factor F_s and the inductive reactors on the calculator, X_c, leaving the capacitors at base values which were originally calculated for an arbitrarily chosen acoustical frequency. The inductive reactance varies as the square of the speed ratio while the scale factor varies directly with the acoustical frequency.

An alternative method varies the electrical frequency supplied to the calculator, leaving the inductors and capacitors at their initial setting. This method was also followed successfully. Consideration must be given to possible errors in the meters at variable frequencies for which the calculator was not originally designed.

The A.C. network calculator consists of calibrated and adjustable inductors, resistors, and capacitors, like enlarged radio parts. These can be combined in any desired arrangement by means of cord banks and plug boards which permit connection as simply as plugging a lamp into a base plug. The main metering desk is rapidly connected to any desired circuit element by small relays selected by push buttons on the desk, somewhat like dialing a phone.

The meters are operated by electronic amplifiers so that the drain upon the system and consequent distortion due to insertion of the meters themselves is negligible. They are in general more accurate and certainly are easier to use than equivalent acoustical devices, such as indicators or flow meters. They can be connected at any desired point in the system far more easily than pressure taps and orifice plates could be inserted in an actual piping system.

The generator used to represent compressors or engines is not a rotating device but rather a phase shifter or a set of coils. To determine *natural frequency* of a piping system only one generator was necessary. In this study a solution for steady state forced and natural vibration was sought. It is also possible, however, to apply transient potentials of arbitrary forms and to photograph the resulting wave forms on an oscillograph.

The highest value of impedance at the generator end, Z_q, was used as a measure of resonance with the applied electrical frequency and hence of the natural frequency of the equivalent acoustical system. The highest impedence indicated the greatest range of pressure oscillation for a given volume current oscillation applied by the fixed piston motion. The effect upon the pressure within the cylinder during valve opening in the actual acoustical system would then be a maximum. These observations were confirmed by the pressure-time diagrams in the studies by Voissel[4] on the intake to a compressor and by Farmer[6] on diesel engines.

Because of the high first cost needed to obtain operating simplicity, few companies can afford to own a calculator. It is usually more practicable to participate in a cooperative agreement with other prospective users or to rent operating time on an existing calculator, of which well over a dozen are available in the country. The work reported here was done at Illinois Institute of Technology.

Results

The electrical analogy method was checked against reported natural frequencies of actual intake or discharge systems of compressors and engines containing air or exhaust gas, with temperatures from room to several hundred degrees. Tests included two and four-stroke cycle engines and single- and double-acting compressors operating at 120 to 1200 rpm, in various combinations. The analogy method also agrees with Warming's graphic method shown in *Fig. 6*, both on his examples and on hypothetical cases.

A 3-cylinder, double-acting compressor was studied extensively, but not included in the thesis. Tests on the calculator indicated severe vibration increasing from 1560 to 1830 vibrations per minute, with a peak vibration in a complex mode at the latter value. This was almost exactly six times normal compressor speed, 300 rpm. A vibrometer held against the discharge piping showed increasingly severe vibration of these same frequencies, always six times engine speed.

Recent information, however, confirms a crankshaft arrangement of the 8-cylinder engine which would give 45° spacing, somewhat resembling *Fig. 4*, with harmonics from only two cylinders adding at six times engine speed, but all cylinders adding at eight times speed. One can only speculate, without further test, as to whether twice the sixth harmonic would exceed eight

times the eighth. No tests were made on the calculator at frequencies corresponding to eight times normal operating speed range. Further study of this particular case is indicated, although the general method seems entirely sound.

For prediction of natural frequencies within 2%, and usually less, only the inertance and capacitance of the system, calculated by essentially acoustical methods, need be considered. The discrepancy in pressure drop due to resistance, large variations of pressure compared to the mean, shock waves, the effects of bends, and the end effect of open pipes and sudden changes in pipe diameter may be neglected.

The analogy as used here does *not* yield quantitative values for pressure variations although they are qualitatively comparable to observations of relative pressure variations on the acoustical systems. Resistance, comparable to an orifice, lowers voltage (and pressure) variation, but resists direct as well as oscillating flow, wasting energy.

Either T-shaped or preferably pi-shaped lumps may be used to represent segments of piping. Some tests indicated that they may be 1/10 of a wave length with less than 1% error in the resonant frequency.

An increase in shunt capacitance between the line and ground, equivalent to increase in receiver volume, *lowers* the natural frequency of the system but decreases the impedance, comparable to decreasing the pressure variations in a practical piping system with constant piston motion. Capacitance near the generator, or receiver volume nearer the piston, is more effective in producing these changes.

The addition of a capped branch pipe at any point along the line also lowers the natural frequency of the system and has greater effect when it is nearer to the compressor. The total of branch plus direct pipe exceeds the length of direct pipe alone needed for a given natural frequency.

Conclusions

It is thus seen that the natural frequency of a piping system can be predicted, resonance with the harmonics of "puffs" from the cylinders can be foreseen, and the effects of variation in manifold volume or pipe length can be predicted inexpensively in the design stage. Indiscriminate adding of receiver volume may well be dangerous because of lowering of natural frequency. Use of an orifice is wasteful and may also be dangerous, but an impedance-capacitance filter comparable to a low-loss muffler can easily be designed by simple experiments.

Support by the industry of a concerted development of design criteria in the form of results on generalized system would seem worthwhile.

APPENDIX

Differential Equations

With resistance and driving force neglected, the spring force applied to the mass in *Fig. 1* equals the mass times its acceleration. The force F due to the spring,

$$-kx \text{ or } -k\int v\,dt,$$

is directed backwards toward the neutral position. (If the system is not horizontal, the effect of gravity balances out if the neutral position is that of equilibrium with the weight on the spring.)

$$F = -kx = -k\int v\,dt = Ma = M\frac{dv}{dt}$$

$$M\frac{dv}{dt} + k\int v\,dt = 0 \qquad \text{Eq. 1}$$

Various electrical engineering texts show, usually from energy considerations, that in the simple circuit in *Fig. 1:*

$$E = L\frac{di}{dt} + \frac{1}{C}\int i\,dt = 0 \qquad \text{Eq. 2}$$

In the acoustical case of the Helmholz resonator, a plug of gas in the neck of a flask can be considered to be the mass. This then is the average density ρ_0 times the volume of the plug, or its length l multiplied by the cross-sectional area A of the neck. With considerable calculations based on the laws of thermodynamics, the restoring force due to the spring effect of the volume V of gas in the flask can be shown to be:

$$F = -P_0\,\gamma\frac{A^2 x}{V} \qquad \text{Eq. 3}$$

Here P_0 = average absolute pressure.

γ = ratio of specific heats and exponent for adiabatic compression; consideration should be given to any effect of supercompressibility.

x = displacement of the plug of gas.

Then in terms of the volume current I, or particle velocity times area, the usual form of Newton's Law or *Equation 1* can be rewritten as:

$$\frac{\rho_0 l}{A}\frac{dI}{dt} + \frac{P_0\,\gamma}{V}\int I\,dt = 0 \qquad \text{Eq. 4}$$

Comparison of *Equations 1, 2,* and *4* shows the same general *form* if the meaning of the symbols is changed. This condition is termed *analogous.* (Thus, $mx - b = 4$ and $ny - c = 6$ are of the same form, linear equations, and might describe analogous conditions, but $x^3 - bx^2 - cx = 4$ would be an entirely different *form* of equation.)

Acoustical and Electrical Values

Comparison of Equations 2 and 4 indicates that certain acoustical properties, determined by the average properties of the gas and the dimensions, may be combined to give the equivalents of inductance and capacitance.

$$\text{Acoustical Impedance } L_a = \frac{\rho_0 l}{A} \qquad \text{Eq. 5}$$

$$\text{Acoustical Capacitance } C_a = \frac{V}{P_0\,\gamma} \qquad \text{Eq. 6}$$

The particular network calculator used had inductive reactance units calibrated directly in terms of the inductive reactance X_c for the calculator frequency, $f_c = 440$ cycles per second. Then for a given acoustical case the base acoustical frequency corresponding to that calculator frequency is mN, or the number of the harmonic whose vector diagrams show a maximum addition of the harmonics of the individual cylinders times the desired base engine or compressor speed.

Inductive Reactance

$$X_c = F_s\,\frac{2\pi}{60}\,m\,N\,\frac{\rho_0 l}{A} \qquad \text{Eq. 7}$$

It will be recalled that the scale factor F_s can be chosen at will. Integral values between one and ten were found convenient for all cases studied.

The capacitors were calibrated in microfarads, so:

$$\text{Calculator Capacitance } C_c = \frac{m\,N}{60\,F_s\,f_c}\,\frac{Al}{\gamma\,P_0} \times 1{,}000{,}000 \qquad \text{Eq. 8}$$

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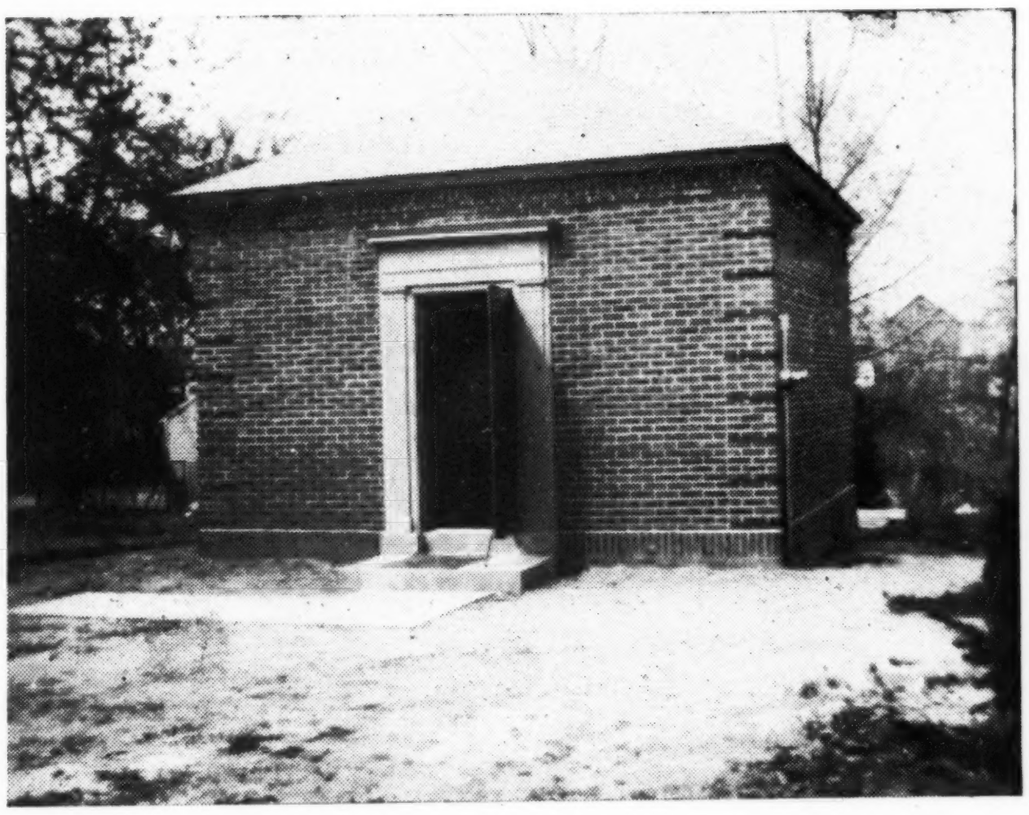


One of the phone company's unattended offices, where delicate machinery is protected by gas- and propane-fired heaters.

Propane installations for two of the offices. At left is the one at Newfoundland, at right the Medford setup.

How Gas Keeps the Phones Ringing

THE New Jersey Bell Telephone Co. now has a policy of using city gas when it is available, and propane beyond the city mains, with unit heaters, for protecting delicate machinery. in the type of community central office which operates automatically without personnel.

Exclusive

When propane is used, installations of from four to eight 100-lb cylinders are provided. the size of the installation depending on the size of the central office. and on the severity of winters in the community served.

Just as the telephone apparatus operates automatically, making dial phone connections for the whole community, the city gas and propane installations also function automatically to keep the temperature and humidity at the right level. At stated intervals someone stops by to inspect the operation. Except for these visits. the automatic stations function without attention.

Other Fuels Replaced

When the New Jersey company started some 10 years ago to build the central offices which carry on without anyone stationed in them, both electric heaters and oil burning floor type radiating heaters were installed for purposes of controlled heating. It was found, however, that electricity was more expensive to use than piped or bottled gas. In the case of oil, experience showed that special ducts were necessary to bring in fresh air, as well as other special equipment. There are, however, seven existing offices with electric heaters and two with the floor type oil heater.

There are also two existing offices and one under construction of a larger type, which are heated by hot water with radiators and steam with unit heaters, using oil burning boilers and equipment.

Both gas from the mains and propane have been found to be satisfactory fuels. They can be automatically controlled with precision that protects the telephone equipment. The use of propane with unit heaters has been increasing, and it is now the company's policy to set up this type of installation when new offices of this type are put in operation and when existing offices that run without personnel are enlarged, if located beyond the city gas mains.

In all these stations, the thermostat is usually kept at 55° and the humidistat at 65% relative humidity.

The four New Jersey communities where unit heaters with propane installations are now functioning are Newfoundland, Succasunna, Allentown and Englishtown. In addition similar installations are under way at Pemberton, Woodbine and Medford, but are not yet completed. The propane used is Essotane, supplied by different New Jersey dealers.

While this type of installation has been in use and giving full satisfaction for about 10 months, the company about eight years ago established and is still using a somewhat different kind of propane setup on Long Beach Island, a long sandy strip off the central part of the New Jersey coast. From the Jersey Central Power & Light Co.'s plant at Beach Haven Park, the propane is piped to unattended telephone central offices at Beach Haven and Beach Arlington. Each of these offices has a floor type heater.

Thirteen Use Gas

There are also 13 unattended central offices where city gas is used. Each of these also has the floor type.

Detailed specifications have been drawn up by the New Jersey Bell Telephone Co. for the heating installations, to assure that materials and workmanship shall be of the highest grade, and the best practice in the trade. Equipment and materials are required to meet the approval of the National Board of Fire Underwriters, and the Schedule Rating Bureau.

Under the specifications for a typical unattended central office using propane, the heating contractor agrees to install a gas-fired unit heater complete with controls, piping, valves, vent, etc. He is required to support the unit heater on suspension type hangers. The unit is furnished complete with heater element, propeller

fan, directly connected electric motor, gas burner with controls, and a substantially constructed housing with adjustable discharge louvers.

The unit heater is required to be vented with a back-draft hood connected to a transite vent and hood on the roof. Capacity specified is 52,000 Btu output at 60° entering air temperature using gas.

The heating contractor is required to furnish and install the following controls for complete automatic control of the system: A standard room thermostat is used in conjunction with a standard humidistat which operates a relay controlling the heating equipment. The controls are wired up by the electrical contractor.

Piping Specifications

The specifications provide for a system of gas piping from the unit heater to a location as shown on drawings, to connect with bottled gas tanks. The pipe used is ½-in. 150-lb copper tubing extending at least 12 in. outside of the building wall with shut-off cock installed on the inside of the wall, where the gas pipe comes through to the heater.

The electrical contractor is required to wire the thermostat, humidistat and relay provided by the heating contractor to the gas heater using BX cable for power wiring and ovalflex with #14 wire for the thermostat and humidistat.

Equipment also includes a transite flue pipe complete with flashing and protective sleeve and necessary supports. The flue is capped with a rotary ventilator. This ventilator is a turbine ball bearing ventilator with 6-in. neck diameter to fit over the transite flue.

The transite flue serves to take fumes out. The rotary ventilator eliminates back-drafts, thus preventing the pilot from blowing out. An additional safety feature provides that in case the pilot should go out, an automatic shut-off valve completely stops the flow of gas.

Safety Air Vent

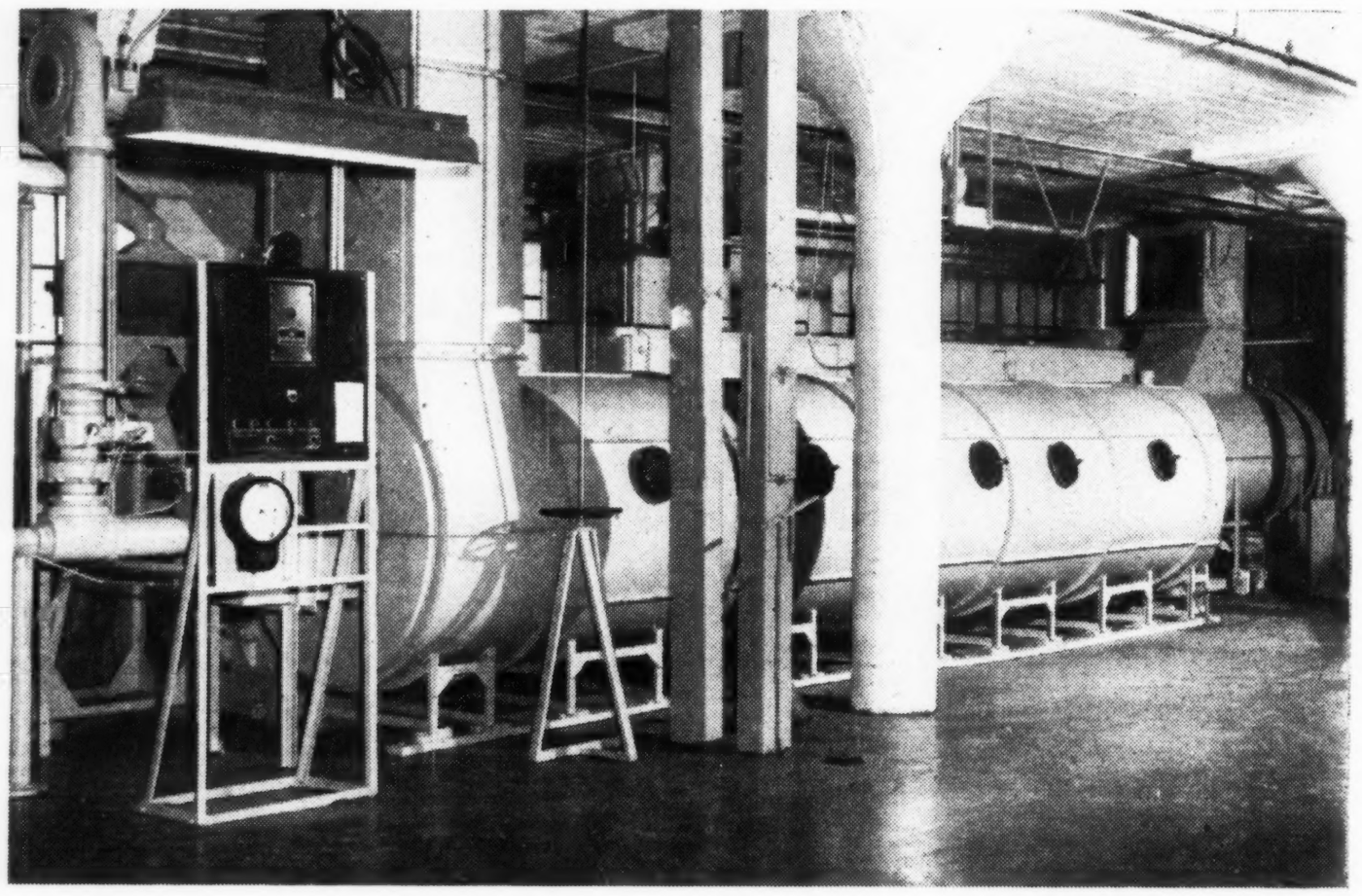
Still another safety feature consists of an air vent in the exterior wall, on which there is always a 2-in. opening per specifications. This would be a final protection against any gas leaks, since the gas would be taken out of the building. It is also used for bringing in outside air for combustion purposes.

The thermostat is placed 4 ft 6 in. above the floor, the humidistat 2 ft above the floor and the relay 2 ft above the floor. It is found that with city gas and propane as fuels and with the kind of a setup specified, it is possible to keep dirt and dust in the office to a minimum, which is essential for the proper operation of the dial equipment housed within.

While it is known that the temperature can get down to 40° without damaging or impeding operation of the equipment through freezing, the thermostat is adjusted to keep the temperature at 55°, in order to allow a good margin and keep the office at a more comfortable temperature for employees entering for inspection or maintenance work.

The unattended central office heated automatically with city gas or propane has proved a practical and efficient setup for the New Jersey Bell Telephone Co., under the rates for gas and electricity in vogue in their territory. Doubtless similar offices and equipment can use this fuel and these types of heating equipment in other parts of the country.

Electrically-Controlled Coffee Roaster



Continuous coffee roaster at S and W's San Francisco plant.

COFFEE roasting has been transformed in the establishment of S and W Fine Foods Inc., in San Francisco. For this all-important process the company has installed a recently-developed scientific marvel—a Jabez-Burns electronically-controlled continuous coffee roaster. The new equipment has replaced four old roasters that did the job in batches and its capacity of 7500 lbs per hour is approximately 50% greater than the total of the four.

S and W's new coffee roaster is entirely automatic, with every operation mechanically regulated or timed. It features indirect heat, from natural gas, and the temperature is kept at precisely the right level by sensitive instruments. Electronic controls prevent any variation in the roasting process. Once set and put into action, it operates hour after hour with uniformly excellent results.

Says William J. Rowe, manager of the coffee department: "The roaster not only has increased volume but also has improved the quality of S and W coffee."

In addition, the new roaster cuts 13 minutes off normal roasting time. Not only does this enable S and W to increase coffee output, but "quick roasting" is considered an essential factor in bringing out the full flavor of the coffee blend.

The Burns roaster consists of two large horizontal cylinders—a heat cylinder, 30 ft long and 4½ ft in diameter, and a revolving oven cylinder, 40 ft long and 4 ft in diameter. Special gas burners develop a temperature of 640° F in the heat cylinder and the heated air is delivered into the oven cylinder in such quantities and at such rate as to maintain in that cylinder a roasting temperature of 375-400°. That air roasts the coffee beans, so they are not exposed to open flames, as was the case in the batch roasters.

Green coffee beans, carefully blended are fed into the oven cylinder in a continuous stream. They are evenly and perfectly roasted during a 5-min trip through the radiated heat, after which they pass into a cooling chamber and in two minutes more are ready for the grinders. The two operations—roasting and cooling—require only seven minutes, compared with 20 minutes under the batch system.

One of a series of service trenchers recently introduced to the industry

The Everett Trencher

ABOVE the Everett Trencher is shown working. Digging speed of the trencher varies from 1½-5 fpm depending on the depth and width of the cut.

AT LEFT the trencher is shown in transportable position. Height to top is 7½ ft. On the road it has a 15-mph traveling speed.

Last July GAS published a resume of the gas industry's specifications for a service trencher, as reported by R. B. Allen at the AGA distribution conference at Pittsburgh last year. The article was followed by a series of features dealing with the products of several manufacturers and comparing the products with the industry's requirements. Herein is described the Everett Trencher, latest of a series which has included the Jeep-A-Trench, the Barber-Greene Runabout, and the Longhorn Mobile Ditcher.

The Everett Manufacturing Co. claims that its Everett Trencher will equal the pick and shovel work of 25 men. This ditcher, mounted on a Ferguson tractor, is driven from the power take-off and raised and lowered by the tractor's hydraulic system.

Here are some of the trencher's specifications, as compared with the specifications listed as generally acceptable by R. B. Allen. (Mr. Allen obtained these specifications from questionnaires mailed to gas companies throughout the United States):

Excavating depth: 3-4 ft: Everett trencher: 3½ ft.

Trench width: 6-8 in.: Everett: 1-1½ ft.

Digging speed: 2-3 fpm; Everett: 1½-5 fpm, depending on the depth and width of the cut and the type of soil.

Maximum weight: Varied from 1500 to 7000 lb; trencher, 1450 lb.

The trencher can be mounted on the Ferguson tractor in 12 or less man-hours. When its speed reduction transmission has been installed, the device can be removed or reinstalled on the tractor in one man-hour. Installation of the speed reduction transmission doesn't affect the regular use and operation of the tractor—all other Ferguson tools and implements that are hydraulically controlled can be handled as if the special transmission had not been installed.

The trencher, a welded and bolted construction of channels, I-beams, angles, and plates, is controlled from the driver's seat. The lowering and raising operations are, of course, hydraulic.

The high-carbon cast steel buckets (15 of them, spaced 12 in. apart) can be lowered to dig trenches to a depth of 42 in. with widths of 12 to 18 in. A trench of additional width can be cut by extending the wheel width of the tractor. Equipment for the digging of 14-16-18 in. trenches is available. The conveyor belt is a 16-in. Goodrich product; from the center of the trench to the delivery end—at right of the trench—it is 48 in.

Speed of the trencher while working varies from 1½ ft to 5 ft per minute, depending upon the depth and width of the cut and the type of soil. The machine works in soft dirt, clay, or adobe.

The speed reduction transmission, fitting between the tractor's transmission and the differential, lengthens the tractor's wheelbase, stabilizes the trencher, makes it easier to keep traveling in a straight line, and assures better operation when the ground is not entirely level, according to the company. The transmission lever enables simple shifting between the digging speeds of from 18 to 60 in. per minute to highway traveling speeds up to 15 mph.

The lever which determines the depth at which the trencher will dig is adjusted with a rope-control handy to the driver's seat. When released, the lever locks the trencher at the desired depth.

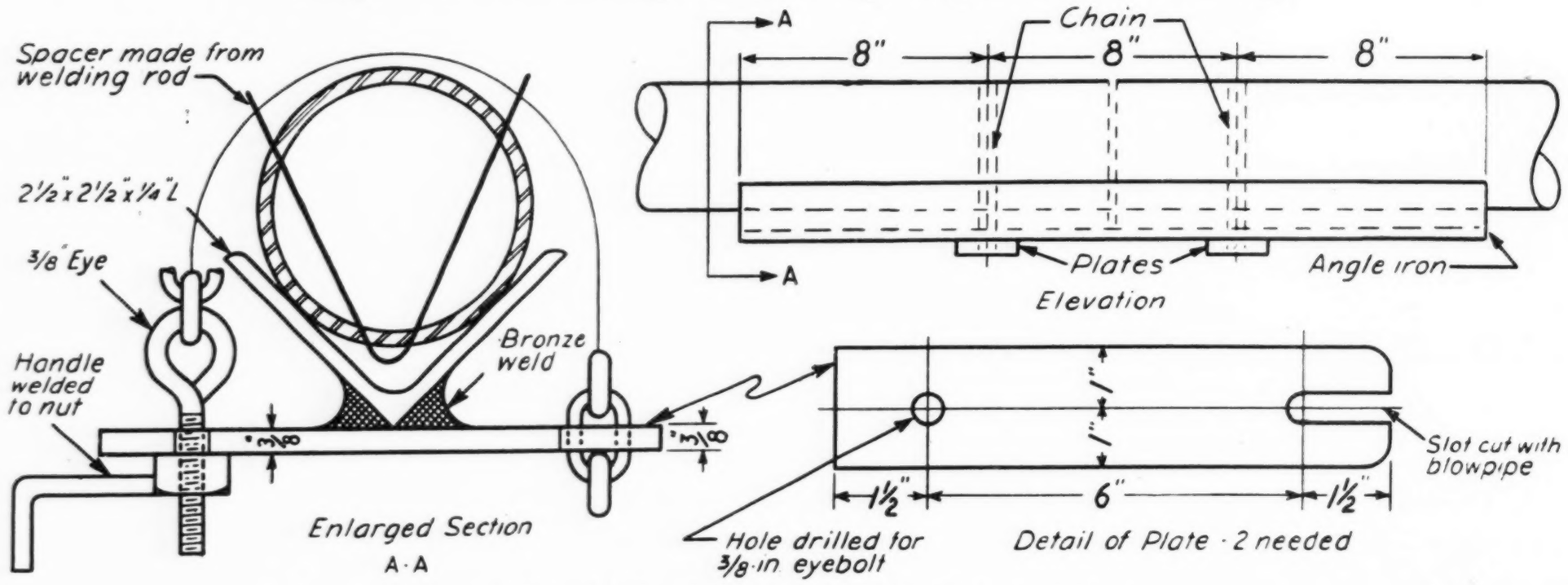
Here are the trencher's dimensions:

Height to top when in transport: 7 ft 6 in.
Over-all length: 13 ft 4 in.
Over-all width: (left rear wheel to right end of conveyor) 6 ft 7 in.
Road clearance: Under own power 6 in.
Extension: Drawbar to extremity of trencher 38 in.

Back-filling attachments may be handled, as the Ferguson tractor will accommodate a bulldozer for front attachment in combination with the trencher.

The Everett Manufacturing Co. is in Phoenix, Ariz.; national distribution of its new Everett Trencher has been placed with The Tractor Sales Corp., Los Angeles. Price of the trencher is $2095.

Shop-Made Clamp Lines Up Pipe for Welding



Construction details of clamp devised for lining up pipe.

"You can do a better welding job on pipe when you get the proper space between the ends, and hold that spacing by proper clamping." says "Linde Tips," publication of Linde Air Products Co. The sketch shows how to make a simple clamp from material probably already on hand in the shop.

To set up the clamp for welding, place the two pipe sections in the angle iron trough. A spacer, made of welding rod is the simplest method to obtain the proper spacing between the pipe ends. To make the spacer, use a blowpipe to heat a piece of welding rod of the desired diameter. Then bend it to a V-shape. Place the spacer rods between the pipe ends, as shown.

Then butt the pipe sections against the rod and fasten the clamp. To make the clamp secure, draw the chains over the pipe and slip a link into the slot. One of the links must bear on the underside of the base plate, as shown in the sketch. Then turn up the nut until the chains are tight. Pull out the spacer rod and make several tack-welds. Loosen clamp and make a finished weld.

This clamp can be used on pipe up to 3 in. in diameter. For larger pipe, increase the length of the angle iron, the base plate and the chains.

Operating Ideas

Salvaging Burners

A suggestion that would help to salvage burners removed on refrigerators because of stripped threads at the orifice earned a $50 award for Ed Nicklas, a serviceman "A" in the customers service department, Brooklyn Union.

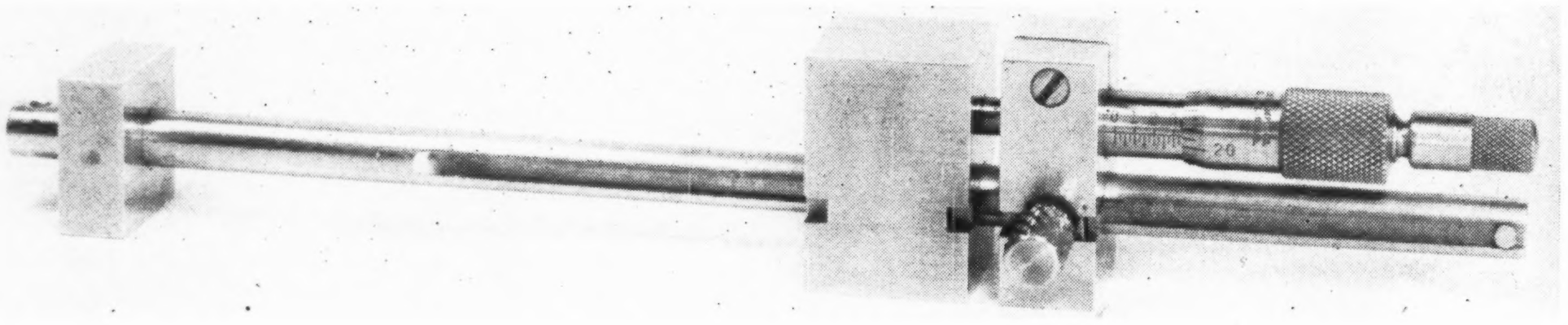
Mr. Nicklas pointed out that after removing the cap screw and old orifice the turbulator could be turned out and the cap screw used as a tap to recondition the threads that hold the orifice. He knew from experience that this has often worked.

To investigate the suggestion ten burners with stripped threads were taken from returned parts and the method was tried. Seven of the ten burners were salvaged. Threads on the others were so badly turned in the seal cap they could not be cleared. The investigating committee learned that a still greater number of stripped burners could be salvaged by using the turbulator or input adjusting screw instead of the seal cap.

The turbulator was found to be more desirable for use in the reconditioning process because it is made of steel whereas the seal cap is made of white metal, a softer material.

As a result of this employee's suggestion it is believed that from 100 to 150 burners which are now changed for stripped threads will be salvaged each year by the company.

Valve Setting Micrometer Gauge Patented



G. Russell King, senior engineer in the gas department, Philadelphia Electric Co., has been awarded a patent for a valve-setting micrometer gauge for gas pressure regulators he invented. The company has used these gauges for some time.

The gauge sets valves exactly, within 0.001 in. so that they seat perfectly when installed in the regulator. It is a precision instrument which eliminates many former operations, effecting savings in both time and labor.

What an outspoken supervisor thinks about it

Are Our Employee Relations Tools Really Effective?

By ORIE VAN RYE

WHAT do personnel men talk about when they get together? I don't mean in formal gatherings but when they talk shop amongst themselves and really let their hair down. I can tell you exactly what occurs at all of them for they are all of one pattern.

They first discuss with some pride the tools they have fashioned: the employee and supervisor's manuals, information bulletins, training and educational programs, employee testing, rating and induction procedures. One or two will boast of having attained one of the goals of all personnel men, the full, sincere backing of management.

And then, the cynic of the group will ask the inevitable question: Are these tools, for which so much money and time are expended, accomplishing their objectives? And the answers will become evasive. Definitely, yes, on the tools for selective hiring, rating of employees, employee training and educational programs; but as to effective two-way communications and improvements in human relations, although they shy away from a flat "no," the answers sound suspiciously like alibies. They run something like this: "Rome wasn't built in a day," or "You can't teach old dogs new tricks"; "We have to wait until some of the men in various levels of management retire"; "It will take a long time because behavior patterns of a lifetime are not easily changed." All these, however, add up to this: an accusing finger pointed at all levels of management.

Misunderstanding

I say this at the risk of incurring some resentment. This, however, may be called a calculated risk. If your reaction is typical, I know you will tell yourself that I am talking about the other fellow. Or you will protest and say, "I *do* believe in having good human relations. I want my employees to respect and like me. I believe in the Golden Rule." And it is also *my* belief that most of you really do.

Then what *is* the trouble? It's that there exists a wide gap between beliefs and conduct. This gap is the same as the gap that exists between our religious beliefs and our conduct.

Recently a nationwide survey was made to determine "how real is the religious faith that underlies our democracy." The $64 question was phrased this way: "Among the people you come in contact with, how far would you say most of them go in following the idea of love of fellow men?" A huge majority, 82%, agreed that *other people* went only part way.

The results of this survey were analyzed by three prominent churchmen and they came to this conclusion:

> The whole history of human self-righteousness proves that man always judges himself *not* from the standpoint of what he does, but from the standpoint of *his knowledge* of what he ought to do.

Still another reason for the existence of this gap between belief and conduct may be due to the fact that in our highly technical business we have chosen our managers, superintendents and supervisors almost exclusively on the basis of *technical* proficiency and knowledge.

Another obstacle is the fact that to some people the term industrial relations means only one thing, the annual battle between union representatives chosen by employees, and the representatives of the company. The competence of the representatives of the company is measured by what success they may have had in making a reasonable settlement of what in many cases are unreasonable demands. This is called the realistic approach. The principal argument for such reasoning is that unions thrive on the human selfishness inherent in all of us and that only through the union leader's success at the bargaining table can he justify his job. Lack of space prevents refutation of this argument in detail here. It should be sufficient to say that many companies have proved this to be wrong.

It is my opinion that the tools that have been fashioned by the personnel men are excellent and they have been accepted as such by industry. For example, the medium of supervisor's conferences as a means to obtain consultative supervision is being used extensively by many industries. The trouble is that it isn't being used for the purpose for which it was designed.

What Supervisor Thinks

Here's what a first line supervisor thinks about it:

The New England Electric System companies recently held a contest for first line supervisors. The contestants were asked to write a letter to an imaginary friend who had been promoted to a supervisory position, telling him in plain words, "What makes a good foreman." Ten prize-winning letters were selected and the winners attended the convention of the National Assn. of Foremen held in Philadelphia. These men were asked on their return to tell about some of the things they learned at the convention in papers presented at their company supervisors' meetings. The following are quoted excerpts from one of these papers presented at a supervisors' meeting last December, and are given with the writer's permission.

"The thing that impressed me most about the meeting was not so much the speakers and the subjects as the foremen themselves and their comments and questions. . . .

"As our own foremen's meetings resume for another year the thought arises once more even as I heard it asked many times at the convention—why? That may appear a peculiar question but I think it is deep in the minds of all foremen. . . . How often have I heard the question, "Why are we here; why does management expect to get more out of us by these meetings; why take up our time with such stuff; why don't we go on as we always have?"

"Of course I know what has been

Mr. Van Rye, personnel counsel for New England Power Service Co., presented this paper at the NEGA Operating Division meeting, Boston, Jan. 13.

told us. These meetings are for the benefit of the foreman, to help him out with his problems, to bring him up to date on current events, to make smooth his path in time of trouble. But to foremen who have supervised men for a number of years as most of the present day foremen have, the situation is rather bewildering. The thought occurs to them: What's wrong with me? Or, more to the point, what's wrong with management? They gave me my job 20 or 30 years ago and it took them a long time to make up their minds that I needed all this extra help. There is a growing suspicion in most foremen's minds that perhaps it is management that has been lax in past years in labor relations and now, with increased union activities, a complete turn-about in labor practice is necessary.

"If such is the case, and in my own mind I believe the facts point to such a conclusion, let's bring it out in the open. Tell the supervisors the exact facts and, if management makes a mistake that has to be rectified, tell the supervisors. We are, I hope, intelligent enough to understand and I know that any foreman entitled to be called such will back management 100%. But let's not have any more of these half-dead meetings or, what is worse, the over-exuberant ones. Let's get together on our problems and settle them like intelligent men.

"However, and slight though it may be, I did notice an irritating element that kept creeping in. Whenever we had a speaker from the strictly foremen's group, we were addressed as 'Management Men of America'; when a management member spoke we were then called 'Members of the Foremen's association.'

Foremen Not Convinced

"I do not believe that the old line of division has completely broken down and the partial failure of supervisors' meetings and conventions is due to the fact that the foreman has not been sold on the idea that management is trying to improve his status in life.

"In conclusion and in recognition of the holiday season I will quote a verse:

"God rest you merry gentlemen
Let nothing you dismay
I hope this won't lose me my job
When it comes Christmas Day!"

This letter really does not need additional comment. However, I should like to point out that when he says "I heard it asked many times at the convention," "I think it is deep in the minds of all foremen," he wasn't trying to rationalize his own feelings.

His concluding verse as did other parts of his paper gives the sad message of a feeling of insecurity. He speaks of the risk one of our better supervisors of long service takes when he has the courage to speak his mind. The fact that his paper was welcomed by the management of his company, that actually there was no risk, that as a matter of fact management felt that for the first time the supervisor's reticence had been overcome, does not make any difference. It is the feeling of insecurity and the mistrust of motives which clearly point to the failure of our objectives.

Although I have been one of those who have constantly used the phrase, "It takes time and Rome wasn't built in a day," I am convinced that we are running out of time. It is my belief that now as never before we need the friendship and the loyalty of our employees in order to survive as business-managed utility companies.

Last month the legislative counsel for several electric and gas companies in Massachusetts spoke before management groups throughout our system. What he said was very much of a shock to those who are not in close touch with employee and public opinion. The following is a brief version of his talk.

The business-managed electric and gas companies have failed to sell themselves to the public and to the voters. Politicians are the most accurate barometers of public opinion, and this opinion is reflected in the type of bills that are presented for legislative action. Filed for action in 1949 are seven bills to investigate electric and gas companies, as well as bills for a gross receipts tax, for development of the waterways, and for the establishment of a state power authority to acquire property by eminent domain, to construct projects and sell power, to issue revenue bonds and to make contracts with other states and Washington.

There are two bills to make it easier to obtain municipal plants. Both bills require a majority vote in one year as against the present provision of a two-thirds vote in each of two years.

One bill would permit the taking over of a private company by a petition filed by 5% of the voters for a referendum at the next election. There are others, none of which will make it any easier for us to do business. Those who doubt whether what happened in the Pacific Northwest and the Tennessee Valley could happen in New England need only to look at the Holyoke Water Power Co., which is now fighting for its very life.

He flatly stated that we not only had failed to sell the public, but we had failed with our own employees. He pointed out that 25,000 employees, their families and their friends could be made a potent factor in forming public opinion in the communities in which they live.

I too believe this can be done if we can shock enough people into the realization that there are other important things besides their technical and operating problems. We must get rid of the complacent attitude that we have a personnel and a public relations department who will take care of these problems.

First, let us take heed to what our supervisor suggested when he said, "Tell us the facts and let's get together on our problems and settle them like intelligent men." To which I would add, "And give us at the same time that feeling of participation on company affairs, that feeling of belonging, of self-importance that all of us crave."

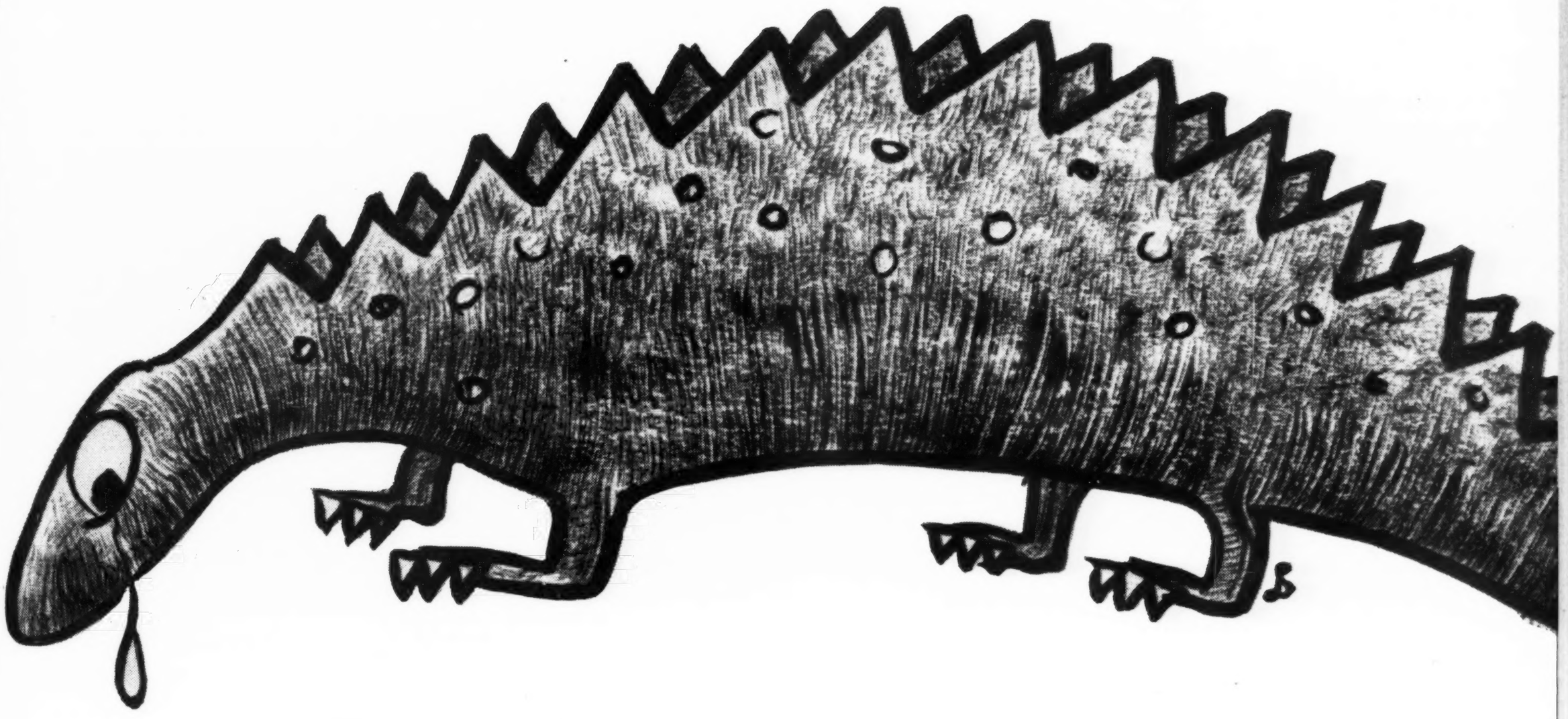
Let us tell the employees in such a way that they may have that feeling. Let us tell them and prove to them that their personal and community welfare is also involved. Translate the pending legislation into terms they can understand and tell them exactly how it will affect them and their company. Enlist the aid of the unions representing the employees.

Two-Way Relations

It can be done. *But*, it can't be done in the spirit of "Boys! We have a hot potato and we need you to handle it." Let it be the start of real two-way communications. Let it be the start of closing that gap that exists between our beliefs and our conduct in everyday operation. And to those who do not want to change the behavior pattern established throughout their past years, let us bring the realization that modern management requires the qualifications, attributes and traits essential to optimum administration of human relations in industry.

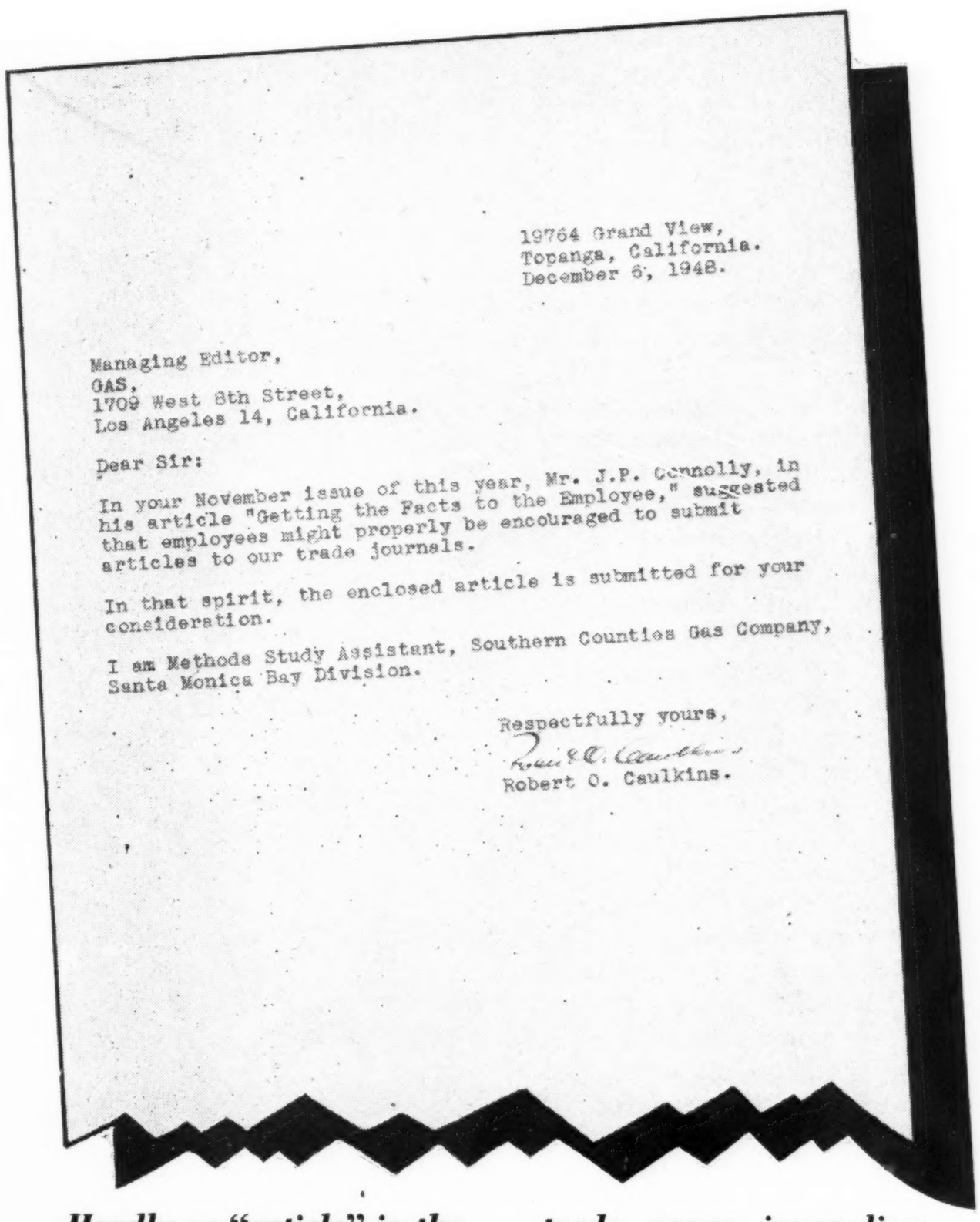
To make it work there must be a recognition of the fundamental necessity of maintaining two-way communication between employees and management. The destructive thinking must be replaced with constructive understanding. There must be constant efforts to inform employees about management policies and objectives, since their future and that of their families is bound up with the future of the company. The ever-present danger of disruptive and dangerous rumor must be eliminated by informing employees of changes before they are made or at least before they appear in the papers.

If these things are done by all levels of management wholeheartedly, sincerely, with a full realization of their importance, we can eliminate the feeling so plainly expressed in the supervisor's paper.



The Fable of the Diplodocus

By ROBERT O. CAULKINS



19764 Grand View,
Topanga, California.
December 6, 1948.

Managing Editor,
GAS,
1709 West 8th Street,
Los Angeles 14, California.

Dear Sir:

In your November issue of this year, Mr. J.P. Connolly, in his article "Getting the Facts to the Employee," suggested that employees might properly be encouraged to submit articles to our trade journals.

In that spirit, the enclosed article is submitted for your consideration.

I am Methods Study Assistant, Southern Counties Gas Company, Santa Monica Bay Division.

Respectfully yours,
R. O. Caulkins
Robert O. Caulkins.

Hardly an "article" in the true sense of the word, Mr. Caulkins, and—in style—somewhat beyond the scope of conventional trade paper journalism. However, we feel it has intrinsic value, so we're publishing it herewith—just as you wrote it.

YOU say the office now wants *three* copies of Form E-791 instead of two, and tomorrow you suppose they'll want four?

Exclusive

Let me get off my dying feet for a minute and sit down here on the curb. You say they no more than tell you to start one job than they come out and tell you to start another one—and then chew you out because you haven't finished the first one? Have they got rocks in their heads?

Well, son, do me a favor while you're standing there. Step on my fingers and straighten them out from gripping the shovel so I can roll a cigarette. Thanks. Now you listen to ol' J. "5-Lite" Beaglehole.

You and I aren't working in a vacuum and neither is the company. Suddenly the city calls up and says they are going to lower the street grade at such and such intersection for a new underpass, and have we got any mains and services in the way. We have, and they have to be lowered. And look up there on the hill right now—they're building houses like crazy. We have to get gas to them at the same time we're renewing old mains that should have been done during the war.

Not only that, there's new legislation, new rulings, new appliances, new methods, new consumers, new industries, and new people working here

who have to be taught the gas business.

You know what happened to the dinosaur they call *Diplodocus*. It finally got so big and so long that it took around one second for an impulse to travel from the tip of its tail to its brain and back again. And by that time it was too late—the changing world had *Diplodocus* by the tail on a downhill pull to the bone yard.

This company is getting big and long, too. But the difference is, we have tools and the brains to use them. Not only to use them, but to redesign old tools to do a better job, and brains to invent new tools for the new jobs we see bearing down on us.

Sure, things are getting complicated. And the more complicated they become, the more control we have to have. You can stab a ¾ plug into 4 lb of pressure—psig, to you—and not have your hat blow off, but try it with 75 lb. And that's exactly what's behind most of these changes you say are driving you nuts—an increase in pressure from all sides.

We just can't sit around and stab any more. Say, for example, the supervisor calls a conference of his foremen. They come into his office, and the last one in closes the door. There is a certain amount of quiet and dignified wisecracking, I suppose, until the supervisor clears his throat and says, "Gentlemen, among other things, all hell's to pay . . . the city states we can no longer use the pushcarts on conversions and move-outs unless we take out peddler licenses. It seems your men have been pushing the fitting carts through the alleys yelling, 'Fish! Fresh fish!' "

What's likely to happen to the conversation at this point? The same thing that happened to the apocryphal character who climbed on his apocryphal horse — he galloped off in four directions. And a half an hour later, the foremen are flipping coins with the supervisor for position on next year's vacation schedule, forgetting all about the pushcarts.

But that's not what happens to the conversation today—not under the conference method—which is a tool built for handling the kind of high pressure that forces a lot of people to come together on a decision. It happens right out here in the field. Just the other morning the foreman said, "Look. It's getting so we can't find a tool on the truck in the same place twice. I just located the tin snips up in the cab in the glove compartment, and the pit gauge in with the close nipples. All of which has got to come to a squeaking halt. What do you suggest we do about it?"

Well, he held us to the subject. We finally concluded that two or three things were causing most of the trouble. And then we decided what we were going to do about these two or three things. And just before he shooed us out to the bell hole, he went back over the high spots of the conference and bore down hard on what was going to be done. And that was that—all in the spirit of what the philosophers call "sweet reasonableness." This morning, I looked all over the truck for the pit gauge. I'd forgot where it was supposed to be and that's where it was.

It's the same deal when it comes to showing somebody how to do a particular job, a job you do so well that your name is going next under Abou Ben Adhem's when the history of the gas business is finally written.

What do we usually do? Why, the job is so easy for us that we THROW it at the new guy, and then say, "Oh, I forgot to tell you. The first thing you do before the thing I told you to do first is to . . . because if you don't, you're likely to get hurt, yakity, yakity, yak."

But not under JIT, we don't. Sure, YOU can build a meter set with your eyes shut. But the pressure is on for new sets, and new people have to be trained. Just the other day, I watched a guy in the shop, using a JIT sheet, build up the inlet side for a curb meter who had never seen one before. And he wasn't so slow about it, either. JIT is another tool—a tool designed to handle the increase in pressure for the training of new people in all kinds of jobs.

Yet you'll find some people fighting not only the increase in pressure on the company, but fighting the tools which were built to control the pressure—control it in a reliable, orderly, planning, cooperative effort. And notice that ol' "5-Lite" said planning, not planned. There's a lot of difference between a planned organization and a PLANNING organization.

But as I said, while we all know better than to fight a hand tool like a 10-in. pipe wrench, we will fight the line and staff setup, or JIT, or the paper work, or the job itself.

And fighting calls for strategy—strategy that's really against the planning, cooperative effort I mentioned a minute ago. In other words, the guy who thinks the people he is working with are like the little pieces of wood strung across the top of a xylophone on which he can hammer out his own tune . . . if he can TALK a good enough job that the higher-ups (he hopes) will hand him the hammers.

I know it burns you up, but you don't have to worry about these people. In the first place, there aren't very many of them. In the second place, one fraud leads to another, and another, and then a fatal one. And in the third place, they don't realize it, but even in the little things they loom up like a holder in a fog—for the simple reason that they are always out for themselves instead of studying and using the tools in a planning, cooperative effort.

Take me, for example. Who's the first one out of the truck when there's some bar testing to be done? Me—ol' "5-Lite"—with the sniffer.

Then there's organization. Say the foreman tells us the way we are starting a particular job won't work and to do it his way. Boom! . . . we are personally insulted. Well, we can stall around until the foreman climbs up in the cab to sign the time cards and then go ahead and "try" to do the job our own way. Or, we can mosey down the street to where the rest of the fellows are putting a couple of leak clamps on a piece of 4-in. scale, and announce to one and all that we have just received final and conclusive evidence that our knuckle-headed foreman is coming off the spool.

Howsomever, we MIGHT go ahead and do the job the way the foreman says to do it, and put twice our usual umphf behind it. Then, one of two things will happen: (a) the foreman is proved wrong in half the time, and the next two coffee breaks for all hands are at his personal expense; or (b) we learn something new about the gas business twice as quick. What can we lose? That's using organization—another tool. And you know what happened to *Diplodocus* on account of the time lag between his tail and his brain . . . and speaking of tails, we better get off of ours because here comes the boss waving a work order. Well, they're not going to get much more work out of J. "5-Lite" Beaglehole today—my old saber wound is killing me.

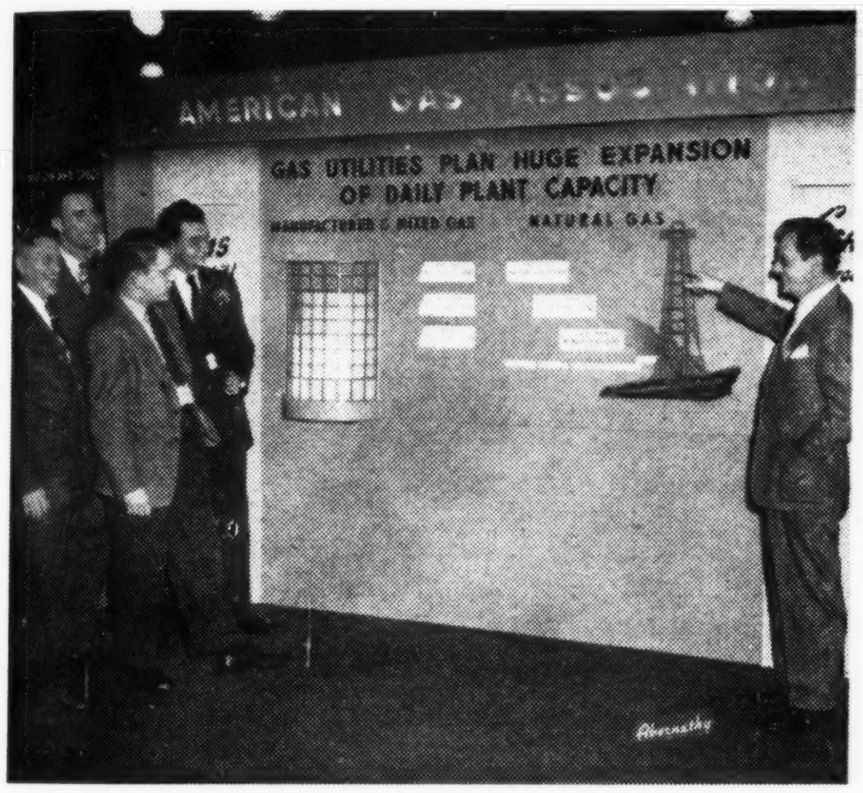
Wrap it up, boys. Somebody's trenching machine just snagged a main up there on the hill where those new houses are.

IN THE SPOTLIGHT

Women prominent in midwinter association activities

HOME SERVICE workshop at Cleveland heard R. J. Vandagriff, sales manager of Laclede, St. Louis.

CLEVELAND SPEAKERS. Seated, from left, Mrs. Mary N. Hall, Elizabethtown Consolidated, Elizabeth, N. J.; Elizabeth J. Lynahan, Peoples, Chicago; Mary Elizabeth Huck, Ohio Fuel Gas, Columbus. Standing, Ruth Sheldon, Washington Gas Light Co.; Mildred R. Clark, Oklahoma Natural, Tulsa; Shirley Fegert, Gas Service Co., Wichita, Kan.



HEATING AND VENTILATING SHOW. C. E. Hall, AGA, explains anticipated daily plant capacity increase chart to Harold Brownell, Joseph Volkstorf, David Monson, Gus Mozarakis, Peoples Gas, Chicago.

NEW OFFICERS AND DIRECTORS of Institute of Gas Heating Industries Inc. Front row: T. R. Bridges, Williams Radiator, vice president; W. R. Dicus, French Heating Co., president; R. O. Montrief, Ward Heater, director; H. F. Haldeman, Harry F. Haldeman Inc., secretary. Back row: Directors F. T. Daniel, Home Heating Service Co.; A. L. Horn, Payne; A. T. Enderle, Frank X. Enderle Inc.

NEW AND OLD. Bert H. Roberts, Minneapolis Gas, new Midwest Industrial Gas Council chairman, is congratulated by retiring chairman Don R. Groff, of Hammond, Ind.

ASSOCIATIONS

Women Serve

Importance of home service stressed at workshop

The AGA Home Service Workshop held in Cleveland Jan. 24-27 was attended by nearly 200 representatives from 31 states. About three-quarters of the conference was made up of first-time representatives who, with the "repeater" delegates, took part in a training and refresher course in home service operation under the program direction of Eleanor Morrison, chairman of the AGA home service committee, and her committee.

Activities at the conference included an opening session symposium on home service given by representatives from all over the country, and an address by R. J. Vandagriff, general sales manager, the Laclede Gas Light Co., St. Louis, in which he outlined the responsibilities of home service representatives and stressed the need for representatives to understand all the policies and plans of their respective companies.

Other Monday speakers included Hugh H. Cuthrell, vice president of the AGA and vice president of the Brooklyn Union Gas Co.; Edwin L. Hall, director of the AGA testing laboratories (his invitation to inspect the laboratories was accepted by a majority of the delegates during the afternoons); and Mary Jean Apt, Gas Service Co., who conducted a demonstration in East Ohio's auditorium for those not visiting the AGA laboratories Monday afternoon.

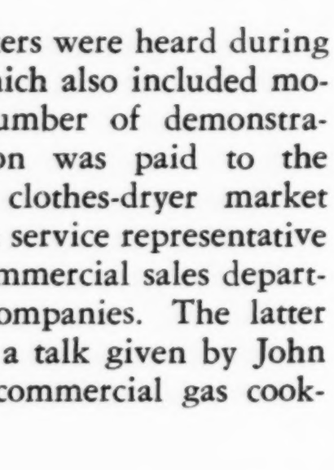
A host of other speakers were heard during the four-day session, which also included motion pictures and a number of demonstrations. Special attention was paid to the steadily-increasing gas clothes-dryer market and the subject of home service representative cooperation with the commercial sales departments of the various companies. The latter subject was featured in a talk given by John J. Bourke, director of commercial gas cooking, the AGA.

Domestic Research

"The very latest technical and operating data and practices will be presented and analyzed by leading engineers in their fields.

"Explanatory data on recently completed and currently active research will bring this subject up to date.

"New ideas and successful practices in the fields of installation, maintenance, and servicing will have a prominent place on the program."



R. J. Rutherford

Thus reads the agenda for the two AGA conferences on Domestic Research and Utilization, one to be presented in Cleveland at the Hotel Statler, March 31-April 1, the other, sponsored jointly with the PCGA, at the Ambassador in Los Angeles, May 26-27. (The latter was postponed from the originally scheduled dates, Feb. 3-4.)

Changing conditions in residential building construction and the demand for higher performance and greater use of automatic features in new appliances have presented new problems of which many will be ironed out at the conferences, according to R. J. Rutherford, chairman. Research and utilization clinics will be set up at both meetings to consider design, servicing, and installation of controls; ignition and venting; and approval requirements.

ASHVE in Chicago

The American Society of Heating and Ventilating Engineers — "Engineers of Human Comfort"—held its 55th annual meeting in Chicago Jan. 24-27, with more than 2000 members attending.

A number of addresses and technical papers were presented, among the latter being a performance study of a hot water heating system using type RC, cast-iron, radiant baseboards in a basementless home. The study was made by Warren S. Harris and R. H. Weigel, special research associate professor of mechanical engineering and special research assistant at the University of Illinois.

Highlights of other addresses and discussions:

An instrument capable of determining the magnitude of net low temperature radiant energy exchange between a surface at the earth and the atmosphere is needed, because of the uncertainty connected with computing radiation exchange and convection loss due to turbulent conditions at an outdoor surface, according to G. V. Parmelee and W. A. Aubele, ASHVE research laboratory.

The cost of successive insulation of windows, ceiling and floors in residences using full scale panel heating is justified under certain conditions of power cost and climatic severity, R. J. Lorenzi of John B. Pierce Foundation and J. F. Schrieber, U. S. Rubber Co., said. The conclusions were based on research in a four-room test house.

Heating plants for floor-panel heated houses should be capable of supplying heat well above expected demand to take care of transsient storage and losses, according to A. B. Algren, University of Minnesota, and Ben Ciscel, Minneapolis-Honeywell.

Other topics under discussion included chimney efficiency, British government research in heating and ventilating, and air shutters on gas-fired conversion burners.

New ASHVE president is Alfred E. Stacy Jr., director of application engineering, Carrier Corp., Syracuse, N. Y. His election by letter-ballot was announced at the conference.

The ASHVE meeting was held concurrently with the 9th annual International Heating and Ventilating Exposition, staged at the International Amphitheatre in Chicago. In addition to this exposition, members attended several other special events in the Chicago area, including an inspection trip to the merchandise testing and development laboratories of Sears, Roebuck & Co.; an inspection trip to the Ilg Electric Ventilating Co. plant; and a trip to the McDonnell & Miller plant and laboratory.

Welcoming address was given by Dr. Henry T. Heald, president of the Illinois Institute of Technology and the Institute of Gas Technology. Toastmaster at the annual banquet was John Howatt, past president of ASHVE, while the speaker was Dr. Clark G. Kuebler, president of Ripon College, Ripon, Wis. During the mornings and evenings a number of technical and business sessions were held.

Personnel Program

"Employee Benefit Plans," a talk by Dr. Raleigh Stone, head of the industrial relations department, University of Chicago, will top the program of the spring meeting of the Great Lakes Personnel Conference, L. A. Brandt, chairman of the personnel committee of the AGA, has announced. Date of the meeting is March 11; the place is the Palmer House, Chicago.

Fred Rauch

Election of officers is also programmed, with nominations to be presented by Chairman Fred Rauch, vice president, Cincinnati Gas & Electric Co. C. B. Boulet, Wisconsin Public Service Corp., and Davis R. Edwards, Columbia Engineering Corp., Columbus, Ohio, are other members of the nominating committee.

The Great Lakes group is the newest of the association's regional conferences.

Eastern Sales Meet

A meaty program is in store for gasmen who attend the Eastern Natural Gas Regional Sales Conference of the AGA at the William Penn hotel in Pittsburgh, March 14-15.

Problems uppermost in the minds of utilities sales department personnel that will be given attention include these:

How the "Court of Flame" program works and how it affects gas companies.

How CP ranges can be used to offset the effectiveness of the electrical industry's new and intensified competitive promotion program.

How local tie-ins with national AGA and CP advertising can be most effective.

What the house heating committee has done to stimulate upgrading of house heating installations to compensate for restrictions on new installations.

What the gas-fired heat pump will mean to the gas industry, economically and from the standpoint of peak loads.

Peak shaving with the combination oil-gas burner.

The effect of laundry dryers and incinerators on a utility's load.

How to sell gas refrigeration in a competitive market.

How realistic dealer participation pays off.

What home service is doing to promote domestic utilization.

An able team has been lined up for the presentations. Stanley G. Gorman, sales promotion director of GAMA's water heating division, will discuss the "Court of Flame." Cecil Dunn, Estate Heatrola, will talk about

ASSOCIATIONS

CP. W. S. Redpath of Ketchum MacLeod & Grove, Pittsburgh ad agency, will point out the local slant in advertising. Progress in upgrading will be outlined by H. P. Morehouse, Public Service Electric & Gas Co., New Jersey. Cy Young, Gas Service Co., Kansas City, and Marvin Smith, Muncie (Ind.) Gear Works, will talk on combination burners and the heat pump. C. H. Rippe, Hamilton Manufacturing Co., will be the gas dryer expert, and Dr. A. W. Gauger, Pennsylvania State College, will explain gas incineration. Gas refrigeration will be expounded by Frank J. Stiening, Hamburg Brothers, Pittsburgh. James F. Howley, Brooklyn Union, will tell why his company's dealer relations program is successful, and Jessie McQueen, AGA, will sell home service.

Raymond Little, Equitable Gas Co., Pittsburgh, chairman of the Eastern Natural Gas Regional Sales Council, planned the show.

Technology School

Lectures, assemblies, an inspection of industrial plants in the vicinity, and a visit to the King ranch, home of Assault and other thoroughbred horses, are in store for an expected throng of 200 engineers and industrialists at the fourth annual Short Course in Gas Technology to be held at the Texas College of Arts and Industries, Kingsville, May 30-June 1.

F. H. Dotterweich

Sponsored by the Southern Gas Assn., the course is again directed by Dr. Frank H. Dotterweich, A&I engineering division director. Other planners include Chester Young, Lone Star Gas, Dallas; D. T. MacRoberts, United Gas Pipe Line Co., Shreveport; W. B. Wood, Rio Grande Valley Gas Co., Brownsville; C. A. McKinney, United Gas Corp., Houston; R. H. Ulrich, Southern Natural, Birmingham; W. C. McGee, Tennessee Gas Transmission, Houston; G. E. May, New Orleans Public Service; R. M. Hutchinson, Houston Natural Gas Corp.; W. H. Ligon, Nashville, SGA president; and Robert Suttle, SGA managing director.

SGA in Biloxi

The 41st convention of the Southern Gas Assn. will be held April 20, 21, and 22 in Biloxi, Miss., with more than 1000 gas men expected to be in attendance. Although a number of special conferences and the home service workshop will take place the morning of the 20th, the convention proper will begin at 2 p. m.

At the Thursday morning general session, Wister H. Ligon will present the president's report; Robert W. Hendee, AGA president, will deliver a paper; and Harrison Jones, chairman of the board of the Coca-Cola

Calendar

March

National Assn. of Corrosion Engineers Annual Convention — Cincinnati, Ohio, March 7-10.

AGA Residential Gas Section, Eastern Natural Gas Regional Sales Conference — William Penn hotel, Pittsburgh, March 14-15.

Oklahoma Utilities Assn. Annual Meeting—Tulsa hotel, Tulsa, Okla., March 17-18.

New England Gas Assn. — Hotel Statler, Boston, March 24-25.

AGA Domestic Research and Utilization Conference—Hotel Statler, Cleveland, Ohio, March 24-25.

Annual Safety Convention & Exposition—Hotel Pennsylvania, New York, March 29-April 1.

Mid-West Regional Gas Sales Conference—Edgewater Beach hotel, Chicago, March 28-30.

April

Industrial Accident Prevention Assn. Convention—Royal York hotel, Toronto, April 4-5.

Distribution, Motor Vehicle & Corrosion Conference—Netherlands Plaza hotel, Cincinnati, April 4-6.

Gas Appliance Manufacturers Assn. Annual Meeting—Broadmoor hotel, Colorado Springs, April 5-7.

AGA Sales Conference on Industrial and Commercial Gas—Andrew Jackson hotel, Nashville, April 5-7.

Gas Meters Assn. of Florida-Georgia Annual Meeting—Ponce de Leon hotel, St. Augustine, Fla., April 10-12.

Mid-West Gas Assn. Annual Convention — Hotel Fort Des Moines, Des Moines, Iowa, April 11-13.

National Assn. of Corrosion Engineers — Netherlands-Plaza hotel, Cincinnati, April 11-14.

AGA-EEI Spring Accounting Conference — Hotel Book - Cadillac, Detroit, Mich., April 11-13.

Southwestern Gas Measurement Short Course — University of Oklahoma, April 12-14.

Midwest Power Conference—Hotel Sherman, Chicago, Ill., April 18-20.

Southern Gas Assn. Annual Convention—Buena Vista hotel, Biloxi, Miss., April 20-22.

The Maryland Utilities Assn. Annual Meeting—Lord Baltimore hotel, Baltimore, April 22.

Indiana Gas Assn. Convention—French Lick Springs hotel, French Lick, Ind., April 28-29.

May

AGA Natural Gas Department Spring Meeting — French Lick Springs, Ind., May 9-10.

LPGA Annual Convention—Palmer House, Chicago, May 9-11.

AGA Industrial Gas School—Hotel Severin, Indianapolis, Ind., May 9-13.

AGA Executive Conference—Netherlands Plaza hotel, Cincinnati, May 12-13.

National Fire Protection Assn.—Fairmont hotel, San Francisco, May 16-19.

Pennsylvania Gas Assn., Annual Convention—Galen Hall, Wernersville, May 17-19.

AGA Production & Chemical Conference — Hotel New Yorker, New York, N. Y., May 23-25.

National Restaurant Exposition—Atlantic City, N. J., May 24-27.

Pacific Coast Domestic Research and Utilization Conference — Ambassador hotel, Los Angeles, May 26-27.

The Natural Gas & Petroleum Assn. of Canada Annual Meeting—Hotel London, London, Ont., May 26-27.

Fourth Annual Short Course in Gas Technology—Texas College of Arts & Industries, Kingsville, May 30-June 1.

National Assn. of Master Plumbers—Annual Convention & Home Comfort Exposition, Cleveland Public auditorium, Cleveland, Ohio, May 30-June 2.

June

Canadian Gas Assn. Annual Convention—Bigwin Inn, Lake of Bays, Ontario, June 16-20.

New York-New Jersey Regional Gas Sales Conference — Essex & Sussex hotel, Spring Lake, N. Y., June 20-21.

Michigan Gas Assn. Annual Convention — Grand hotel, Mackinac Island, Mich., June 24-25.

September

Pacific Coast Gas Assn. Annual Convention—Santa Barbara, Calif., Sept. 7-9.

The Maryland Utilities Assn. Fall Conference—Cavalier hotel, Virginia Beach, Va., Sept. 16-17.

National Butane-Propane Assn.—Jefferson hotel, St. Louis, Sept. 19-21.

October

American Gas Assn. Annual Convention—Chicago, Oct. 17-20.

National Safety Congress—Morris hotel, Chicago, Oct. 31-Nov. 4.

Bottling Co. of Atlanta will give an address.

Friday morning's general session will be headed by L. L. Baxter, first vice president. At the meeting the AGA's PAR program will be presented. Speakers will include Robert A. Hornby, vice president, Pacific Lighting Corp.; Edward P. Noppel, Ebasco Services Inc.; and Frank C. Smith, Houston Natural Gas Corp.

Gas men attending the Friday noon general session luncheon at the Buena Vista hotel, convention headquarters, will hear Rev. Bill Alexander, Oklahoma City minister, who has recently returned from England and will give information about the nationalization of British industries and its effect on the British economy.

In addition to the general sessions, a number of other meetings are scheduled for the various section advisory committees, with the first meetings scheduled for Wednesday morning.

Midwest Sales Meet

The AGA is expecting 800 utility men and manufacturers to put in an appearance at the Mid-West Regional Gas Sales Conference, to be held March 28-30 at the Edgewater Beach hotel in Chicago, under the auspices of the residential gas section. The program designed by Chairman W. L. Hayes, Montana-Dakota Utilities, Minneapolis, and H. D. Valentine of Peoples, Chicago, is intended to assure them that their time is well spent.

Everything from LP-Gas to human relations will be discussed at the meeting, which will feature such speakers as Carl V. Haecker, Butler Brothers' sales promotion manager; Dr. Irving J. Lee, Northwestern University; Henry W. Persons, Mutual Life Insurance Co., and Dr. Kenneth MacFarland, Topeka, Kan. Specific subjects include the controversial gas-oil combination heater, dealer relations, house-to-house canvassing, economics, business conditions in general, and the "Court of Flame" project, the latter to be described by AGA Managing Director H. Carl Wolf.

Industrial Gas Council

The annual meeting of the Midwest Industrial Gas Council was held at the LaSalle hotel, Chicago, on Jan. 28, and was well attended by industrial gas men from all sections of the Middle West.

Ralph D. Allen, Minneapolis-Honeywell Regulator Co., opened the morning session with an informative talk on "Electronic Flame Protective Devices" and "Underwriters' and Factory Mutual Requirements." He used large charts to help illustrate his remarks.

Bert H. Roberts, Minneapolis Gas Co., was elected chairman for the coming year. Other new officers: vice chairman, Fred C. Utterback, Public Service Co. of Northern Illinois, Chicago; secretary-treasurer, Paul F. Gibson, Western United Gas & Electric Co., Aurora, Illinois.

Large humorous cartoons and skillful showmanship proved a happy combination for Raymond W. Fenton, assistant advertising manager, The Peoples Gas Light and Coke Co., Chicago, as he successfully held the attention of his audience while stressing the importance of "Publicizing Industrial and Commercial Gas." Larry Shoemaker, Northern Natural Gas Co., spoke on the "Future of Industrial Gas from Pipeline Companies' Point of View." The meeting closed with the presentation of the sound film "The Eternal Flame."

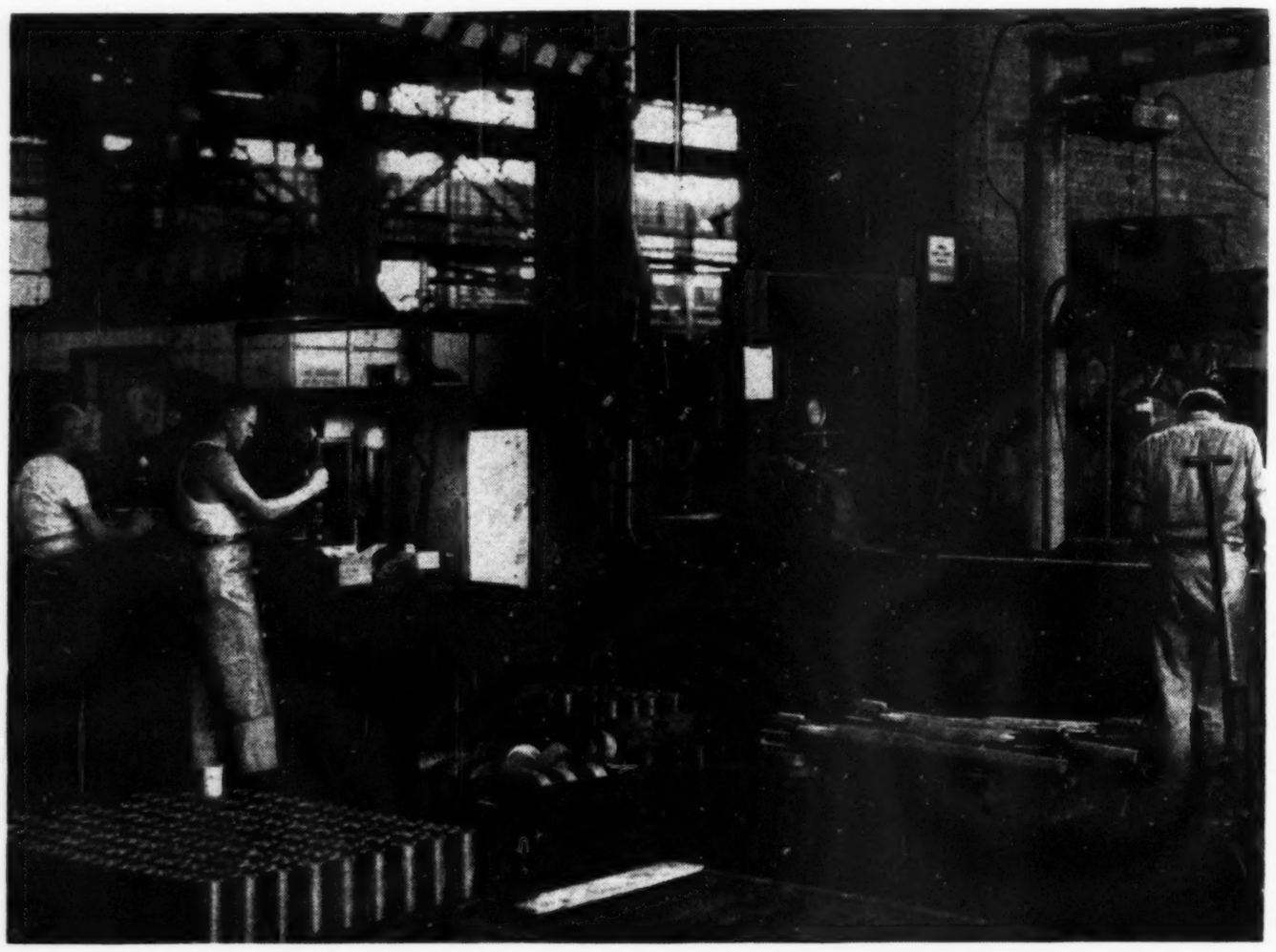
A two-day session of the council will be held in Waukegan, Ill., on June 2 and 3, under the sponsorship of the North Shore Gas Co.

Penn Men Pick Isherwood

J. H. Isherwood, Allegany Gas Co., Port Allegany, Pa., was elected at the January meeting of the Pennsylvania Natural Gas Men's Assn. to the office of presidency for the 1949 year. Irving K. Peck, Manufacturers Light & Heat Co., Pittsburgh, was named vice president; P. L. Kesel, Pittsburgh, secretary-treasurer; Mark Shields, Pittsburgh, executive secretary, and B. H. Smyers Jr., Pittsburgh, counsel.

The following directors were also elected: C. E. Bennett, Manufacturers; E. M. Borger, Peoples Natural, Pittsburgh; H. D. Freeland, Waynesburg; D. P. Hartson, Equitable Gas Co., Pittsburgh; Mr. Isherwood; J. J. Jacob Jr., Peoples; D. S. Keenan, Carnegie Natural, Pittsburgh; Mr. Peck; B. D. Phillips, Butler; H. H. Pigott, Equitable; and G. E. Welker, United Natural Gas Co., Oil City.

Gas Has Big Role in Metal Show



Heat treatment of alloy steels at high temperatures will occupy a prominent place in discussions at Western Metal Congress in Los Angeles next month.

Many papers on corrosion of pipe or other buried structures and on industrial applications of gas have been included in technical programs of the Western Metal Congress, April 11-15 in Shrine Convention Hall and the Biltmore, Los Angeles.

"Recent Changes in Pressure-Vessel Codes" will be the topic of Elmer O. Bergman, consulting engineer, C. F. Braun & Co., Alhambra, Calif. The new California code for compressed gases will be interpreted by George A. Sherman, State Division of Industrial Safety, San Francisco. Both men will speak on an American Welding Society program starting at 9:30 a.m., April 15 in the Biltmore.

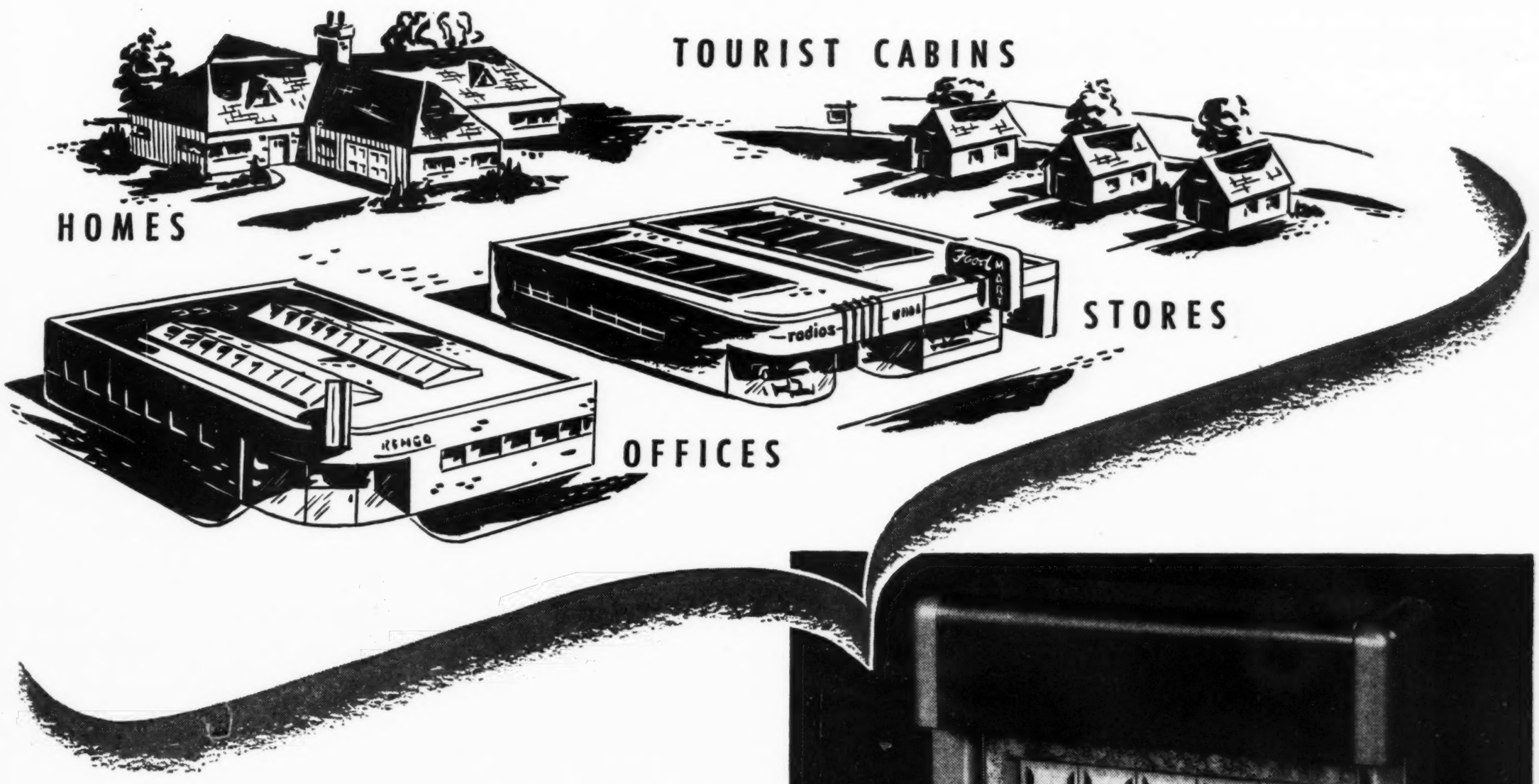
"Tandem-Arc Submerged Melt Welding of Line Pipe" is the subject for Charles A. Babbitt, vice president, Cal-Metal Corp., Torrance, and "Automatic Welding of Pressure Vessels" will be described by Clinton E. Swift, welding engineer, C. F. Braun, at another AWS session set for the same hour and place April 11.

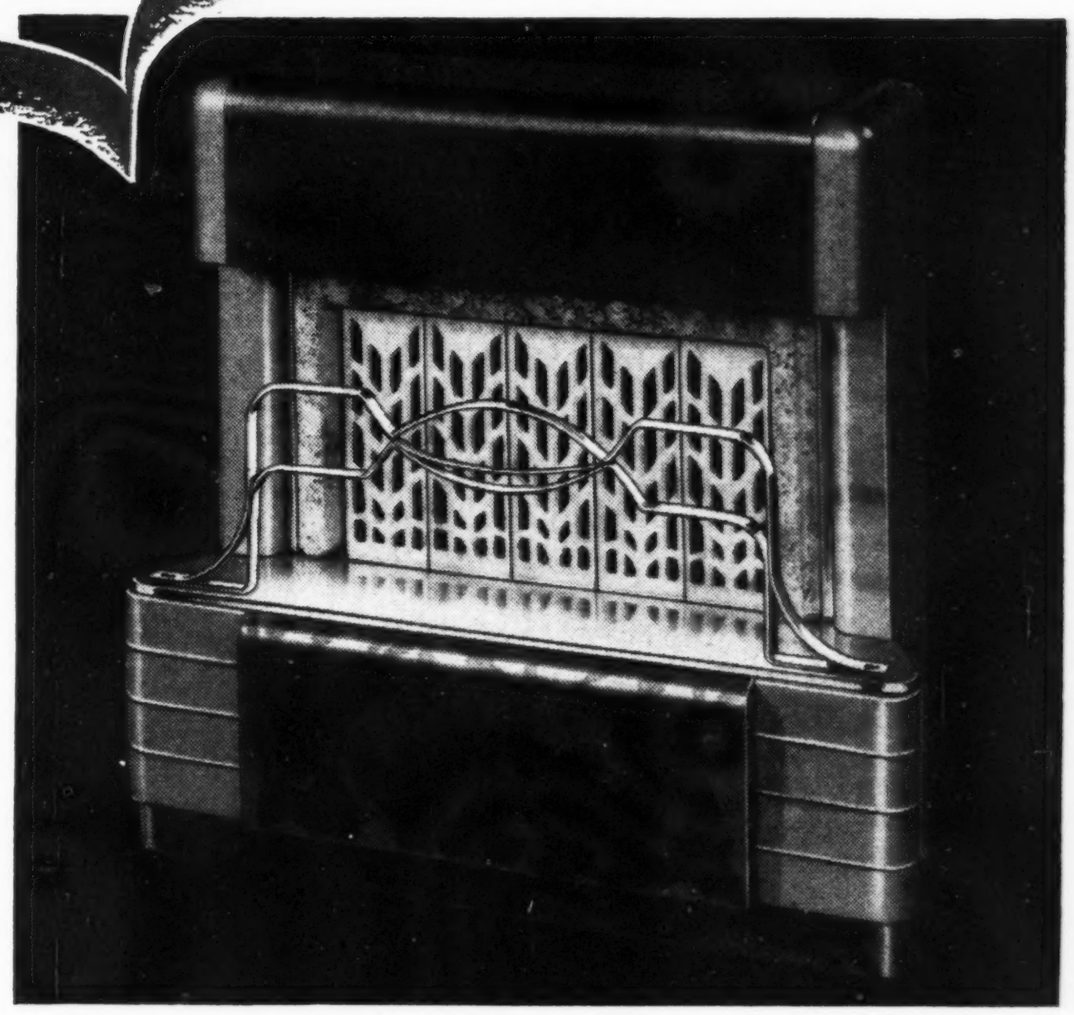
With many papers applying to gas industry problems, the American Society for Metals will present a symposium on corrosion. The morning session April 12 will be in the Biltmore, with an afternoon follow-up in the Shrine building.

Topics include "Protection Against Corrosion" by Charles F. Munger, American Pipe and Construction Co., Los Angeles; "Statistical Methods of Evaluating Corrosion Damage," by Aaron Wachter, Shell Development Co., Emeryville, Calif., and "Corrosion Problems in the Petroleum Industry" by W. W. King, Standard Oil, San Francisco. A chemical engineering authority, yet to be announced, will outline "Fundamental Theories of Corrosion."

Heat treating developments will be stressed by numerous exhibits in the five-day Western Metal Exposition, Shrine Convention Hall.

With the Pacific Coast Gas Assn. and Western Oil and Gas Assn. among approximately 20 technical societies cooperating in the combined event, members of these and other technical groups will be admitted without charge to technical sessions and the exposition.





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EXPANSION

Gas in Oak Ridge

Steel allocated to East Tennessee

Construction of a 164-mile pipeline from Mitchellville, Tenn., to Oak Ridge by the East Tennessee Natural Gas Co., Chattanooga, is on the way. The Atomic Energy Commission's plant in eastern Tennessee will receive a firm supply of 60 MMcf daily through Mitchellville facilities of the Tennessee Gas Transmission Co. Pipe for the project—25,500 tons of 22-in. steel pipe—was allocated to East Tennessee by the OIC late in January.

The initial contract with the utility was signed last June, and is of 20 years duration from the date of first delivery, with a 12-mo. written notice termination clause.

The gas will be used in conjunction with operations at the U-235 production plant, to which the AEC plans to make a $70 million addition in the near future. Other facilities may be converted to the utilization of gas later. J. C. Franklin, manager of Oak Ridge operations, held out the possibility that Oak Ridge homes may eventually be provided with the fuel.

* * *

An $11½ million project of East Tennessee's, consisting of a 186-mile line from Tennessee Gas' main line to the Chickamauga Dam area near Chattanooga and a 112-mi. line extending on to a point near Knoxville, has had its starting date held up because of the shortage of steel pipe. The FPC has granted the company a six-month extension; the original deadline set by the commission was Feb. 2.

2000 Miles of Pipe

In the last six months of 1948 the FPC authorized natural gas transmission facilities which involve more than 2000 miles of pipeline and a daily capacity of more than 600 MMcf. Estimated cost for the whole works was set at slightly more than $191 million, of which almost $140 million was for major projects costing $700,000 or more.

Largest single authorization was to El Paso Natural, giving it the okay to construct about 720 miles of pipeline, adding some 180 MMcf daily of delivery capacity to the company's system. Other large projects included a 515 mile authorization to Tennessee Gas Transmission Co. and a 103-mile project undertaken by Southern California Gas Co. and Southern Counties Gas Co. of California.

Installation of compressor units under certificates of public convenience and necessity totaled 150,304 hp.

Seaboard Pipeline

Atlantic Seaboard Corp. and Virginia Gas Transmission Co. (both Columbia Gas System Inc. subsidiaries) have received FPC authorization to construct additional natural gas transmission facilities to supply increased requirements of the two companies' customers in Maryland, Virginia, West Virginia, and the District of Columbia. Estimated cost: $20 million.

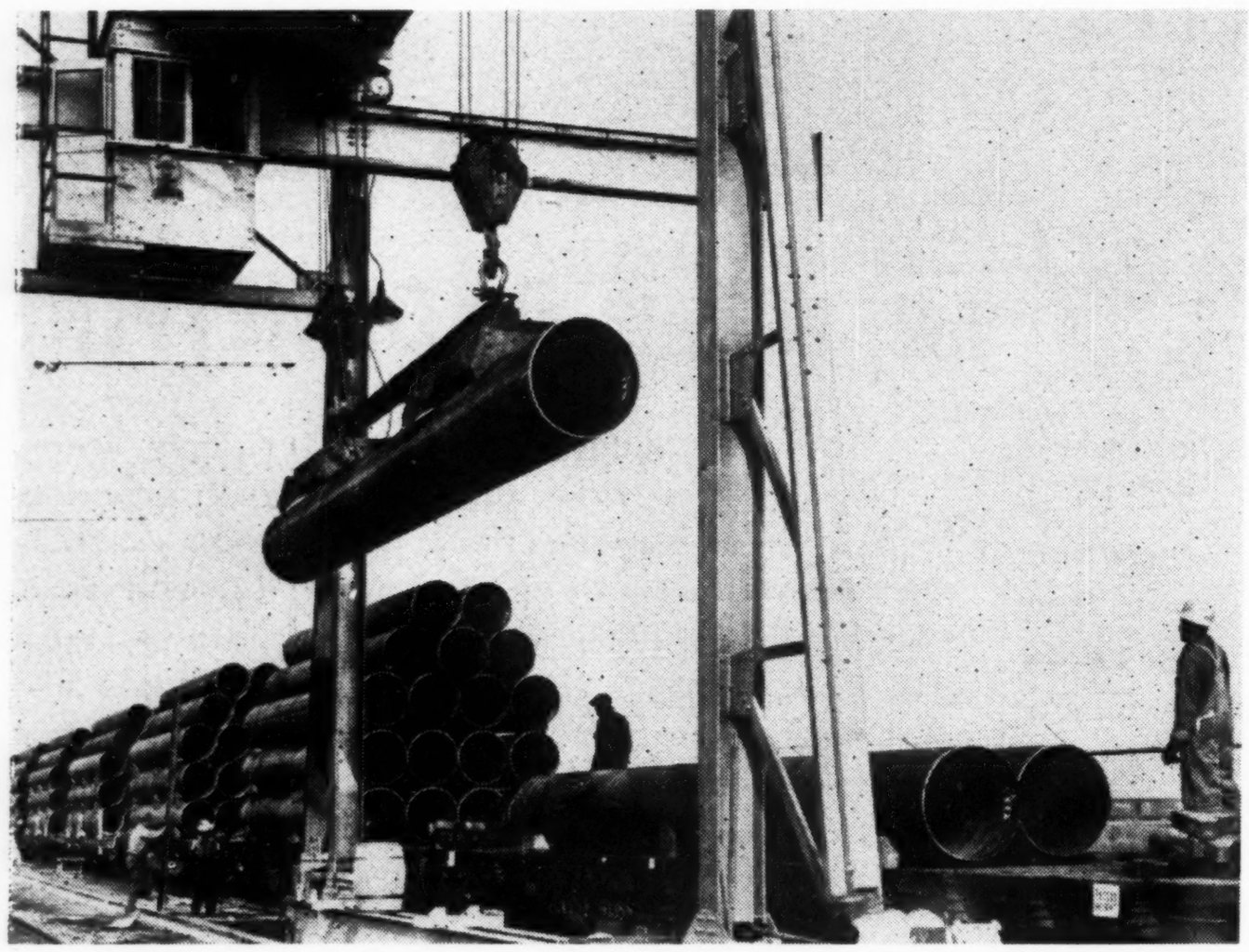
Facilities will include 268 miles of 26-in. pipeline extending from Clendenin, W. Va. to Rockville, Md., a multiple crossing of the Potomac river near Rockville, and additional measuring and regulating equipment along the line. Atlantic Seaboard will build the 193 miles of line in West Virginia and Maryland, with Virginia Gas building the remaining Virginia portion. The line connects with Atlantic Seaboard's existing main line at Rockville, and must be completed by Mar. 1, 1950, according to FPC order.

Petitions of intervenors, including Consolidated Gas Electric Light and Power Co., of Baltimore, were taken note of, with the FPC deciding that their demands couldn't be met "without excessive curtailment of the requirements of existing customers of the Columbia system." In approving Columbia's application, the FPC severed it from the proceeding involving Tennessee Gas Transmission Co., with which it had previously been consolidated.

Storage Setup Okayed

A Michigan Gas Storage Co. (Jackson, Mich.) storage project, held up because of the unavailability of FPC-authorized 24-in. pipe, will go ahead with substituted 20-in. pipe and some additional compressor station power. The FPC modified the 1946 order, which okayed the project, to allow the substitution of 113 miles of the smaller pipe and the installation of additional compressor units in the company's Freedom Junction station which will boost the power there from 6400 hp to 8400 hp and to add another station of 4000 hp at Lainsburg Junction.

The FPC also authorized Michigan Gas to make temporary use of certain pipeline facilities of Consumers Power Co. pending completion of the complete 20-in. line in 1950. With the storage facilities in the Winterfield and Cranberry Lake gas fields already authorized, increased sales in the 1949-1950 winter season are seen for Michigan customers.



For the World's Longest Pipeline

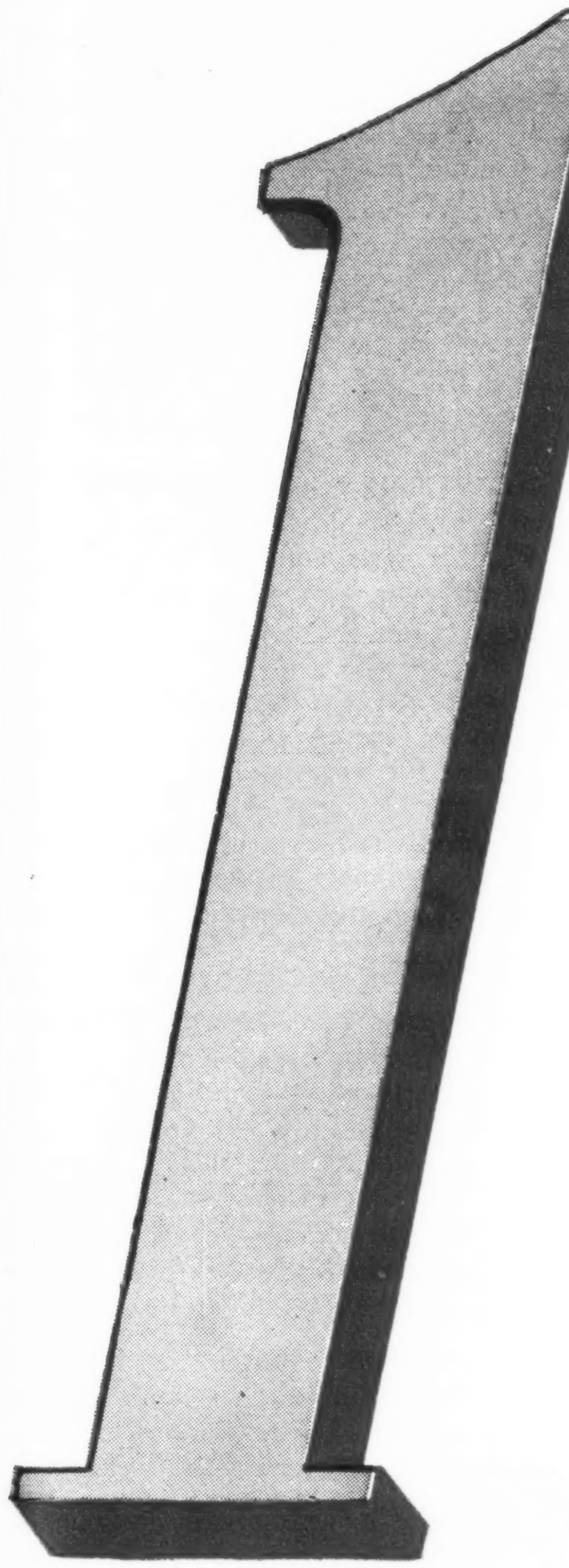
Consigned to Trans-Continental Gas Pipe Line Corp. in Texas for construction of the world's longest pipeline—from Texas to New York—this initial shipment of 30-in. pipe is the first of approximately 20,000 carloads. Consolidated Western Steel Corp., Los Angeles, fabricated the pipe. The first shipment comprised the longest trainload of pipe in the history of the Santa Fe Railroad, 100 cars. Total length: nearly 10 miles. Total weight: 2500 tons.

More than 470,000 tons of steel will be needed to complete the 1840-mile pipeline, which will cost an estimated $190 million.

Natural for Arkansas

Natural gas will be available to industrial and domestic consumers in eastern Arkansas within "the near future," according to W. H. Howze, division manager of the Arkansas Power and Light Co. The company has announced plans for construction of a $9 million steam generating plant and distribution system near Marianna, Ark., and will use natural gas for fuel.

1ST



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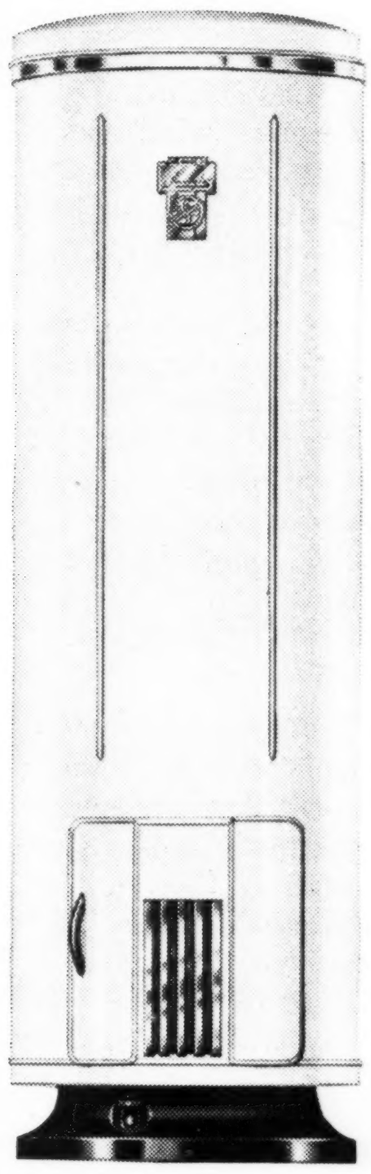
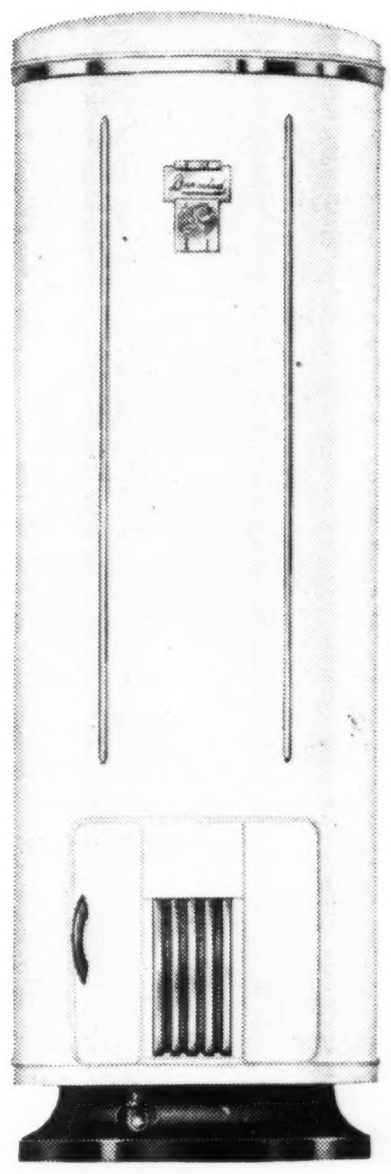
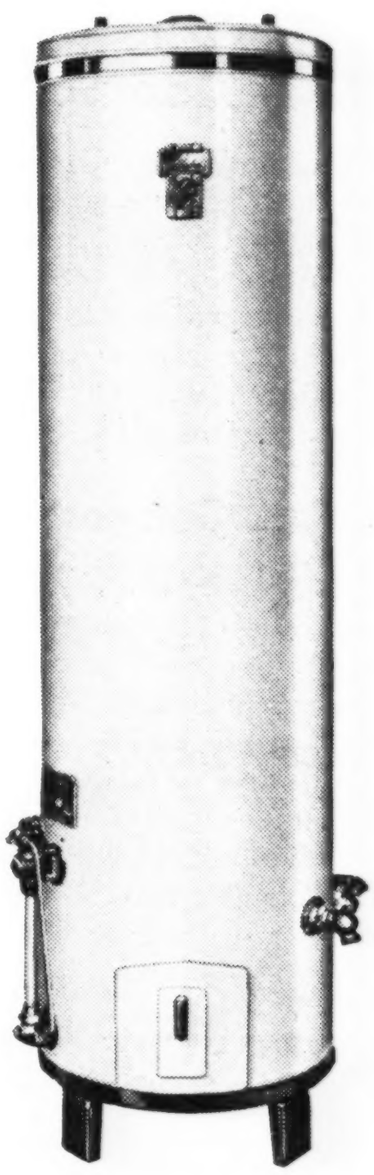


Permaglas
(De luxe glass-lined)



Duraclad
(De luxe zinc-lined)



Milwaukee
(Standard zinc-lined)

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Power Plant Consumption

Electric utility power plants consumed a record 476 billion cu ft of gas in 1948 in the production of electric energy, according to the FPC. Previous high was set in 1947, the new mark being an increase of 27.8% over the old figure.

Gas use during the month of December, 1948, amounted to slightly more than 36 billion cu ft. This was 21.2% more than the previous year, but 8.7% below November's consumption.

San Diego Line Set

Southern Counties Gas Co. and San Diego Gas & Electric Co. have received California public utilities commission approval for their projected construction of an 85-mile, 16-in. transmission line which will bring an additional 40 MMcf of natural gas to San Diego from the Biggest Inch. On FPC okay, construction will start June 15.

Laclede to Convert

Laclede Gas Light Co., St. Louis, plans to convert its St. Louis county customers to natural next summer. Plans are contingent on the present schedule for Mississippi Valley Fuel Corp., Laclede supplier, to receive steel for additional pipeline facilities.

Laclede serves 70,000 customers in the county; an additional 15-20,000 customers in North St. Louis also may be included in the conversion.

FINANCIAL

Rate Roundup

When major oil companies dropped the price of oil for gas late in January the rate schedules of at least two large utilities were affected. With the rest of the country's utilities still needing and asking for higher rates, Portland Gas & Coke (Oregon) reversed the trend and knocked 6 cents per Mcf off its residential rates; across the continent, Brooklyn Union Gas Co. had $175,000 of a recently granted rate rise slashed for the same reason: lowered oil prices. The price cut has been laid to three factors: over-supply, strenuous competition, and unusually warm weather in some parts of the nation.

Michigan Consolidated Gas Co. has received an interim increase which will bring in $7¼ million between now and completion of the Michigan-Wisconsin pipeline from Texas next year. The Michigan public service commission refused to grant an asked rate increase which would have added almost $13 million to the company's revenue, but did allow it a 14 cents per Mcf surcharge for all customers using in excess of 2.5 Mcf per month. The increase is temporary, to allow the company to manufacture supplementary gas profitably.

Attorney General S. J. Roth stirred up a mild storm when he said that the interim increase was "illegal." He said that "the public interest is not being properly protected," and has asked Gov. Williams to suggest a change in the laws which would allow the

attorney general to intervene in such cases. Mr. Roth said that utilities might be protected by letting the rates go up, but that the revenues gained thereby should be impounded until courts could rule on the rates.

Final action on the total requested increase will be taken by the commission shortly.

Portland Gas & Coke Co. is cutting its rates, total savings to customers being about $½ million. The move is a result of the 25 cents per barrel reduction in the cost of gas-making oil as announced by major oil companies in late January.

The drop is based on the oil price adjustment provision in the company's Oregon rate tariffs. It will amount to 6 cents per Mcf of gas consumed. The provision calls for 1.2 cent reduction per Mcf of gas for each 5 cents per barrel drop in the cost of the oil.

All customers, residential, commercial, and industrial, will be benefited. To supply its customers, Portland Gas uses approximately 2.6 million barrels of oil annually.

Brooklyn Union Gas Co. received a late-January increase from the New York public service commission which will boost revenues by $1,025,000. The company asked for $2,200,000. It has now received four authorized increases from the commission since July, 1947. Total rate rise revenue since then is nearly $9 million. A $1,200,000 increase was first set, but the recent lowering of bunker C oil costs cut off $175,000.

The company serves 800,000 customers in Brooklyn and Queens.

Minimum charges will be raised 3 cents per month, while gas in excess of the minimum amount will be raised 2½ cents per 100 cu ft. Increased labor and production costs were cited in the request.

Consolidated Edison Co. of New York faces a possible rehearing on its recently granted gas rate hike; Mayor O'Dwyer has petitioned the state public service commission to reopen the case on the grounds that inequitable rates were fixed. It is claimed that the commission erred in fixing the value of useful assets of the company's operations.

The company, in turn, claims that the rates are not inequitable, and points out that this has been the first gas rate increase granted since rates were set in 1922.

Troubles grow on trees for Consolidated—at the same time the commission upped its gas rates it knocked off about $22 million of its electrical revenues. The gas rate raise (bringing in nearly $12 million) was small solace for this slash, and now it looks as if the company may lose what solace it had.

Southern Counties Gas Co., Los Angeles, has applied to the California public utilities commission for permission to establish new rate schedules for large volume users. About 11,000 of the system's 300,000 customers would be affected. They would include general service customers using more 20 Mcf monthly, and firm and interruptible industrial customers.

Some users will receive an increase and some a decrease under the new schedules; most of the company's present rates are subject to automatic adjustments based on its earnings and in some areas both firm and interruptible users have received gas at the same price. Revenue increase to the company will vary between $131,000 and $223,000, depending upon which optional rate large volume industrial customers select.

Connecticut Light & Light Co. has been authorized by the Connecticut commission to file new schedules to increase rates, bringing the company an additional $2.1 million annually. The company has asked for $3.6 million.

Electric rate boosts will account for most of the raise, with the illuminating gas rate increase amounting to $511,000. Connecticut Light supplies gas to 26 of the state's 169 towns, and electricity to 106.

Oops!

GAS learned last month — the hard way—the power of a little oxygen.

The editors had an article—a very excellent article — on the "Utilization of Carbon Dioxide Extracted from Natural Gas in the Production of Dry Ice." But somewhere in the typewriter of one of them there must have been lurking a gremlin left over from the last war, a dirty little character who specializes in pushing wrong keys.

So—on p. 30 of the February issue of *GAS* there appeared a story titled "Utilization of Carbon *Monoxide* Extracted from Natural Gas in the Production of Dry Ice." The sharper-eyed of our friends (we still have some, despite the error) threw up their hands in horror and hastened to call it to our attention. So we're calling it to yours . . . and hoping you won't call it to that of the electrical industry, which *could* make capital of it.

We have sent the gremlin packing back to the Pentagon building.

Affiliated Sets Up Shop

Formal announcement of the formation of Affiliated Gas Equipment Inc. has been made by Lyle C. Harvey, president and general manager of the new company. Three companies, Bryant Heater Co. of Cleveland, Payne Furnace Co. of Beverly Hills, and Day & Night Manufacturing Co. of Monrovia, Calif., make up the new corporation. They are former subsidiaries of Dresser Industries Inc., and formed the gas appliance division of that company. They were sold to Affiliated Jan. 12 for $10,870,000. Affiliated will continue the companies' manufacture of heating, water heating, and air-conditioning equipment.

L. C. Harvey

The new company is offering to the public 1 million shares of common stock at $9.25 per share and 40,000 shares of cumulative preferred stock at $50 per share, through an underwriting group headed by Reynolds &

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Co. of New York. The company has secured a 15-year term loan from three insurance companies for a total of $4 million.

City Wins Rate Suit

The circuit judge in Mt. Pleasant, Mich., early last month ruled in favor of the City of Mt. Pleasant in its injunction suit against Michigan Consolidated Gas Co., holding that the city was entitled to rates predicated on terms of a franchise and could not be rated in company with other cities.

The judge ruled that the city was entitled to natural gas as long as it was available, and that the company could not charge the cost of manufactured gas not used by the city under a district rate.

1948 Total Sales

In 1948 total sales of gas amounted to 32,532,544,000 therms, an increase of 9.1% over the previous year, according to the AGA. Sales to ultimate consumers in December itself were 3,176,126,000 therms, a 6.3% gain. The AGA also reports that its index of total gas sales on Dec. 31, 1948, stood at 217.3% of the 1935-1939 average.

Changeovers to straight natural gas by some companies and temperate weather in many areas dropped sales of manufactured and mixed gas. A drop of 8.1% for manufactured and 19.4% for mixed gas made these totals 214,457,000 and 116,748,000 therms, respectively.

Natural gas sales were up 9%, for a total of 2,844,921,000 therms.

The FPC reports that operating revenues

for natural gas companies during November of last year totaled $76,815,057, a 19.7% increase over the same month of the previous year. Gas utility operating income was $13,887,335 for November, this amounting to a 35.3% gain. Net income for the month was $14,690,354.

Dresser Earnings Told

Dresser Industries Inc. in the company's annual report, has declared that net earnings for the fiscal year ended Oct. 31, 1948, were $8,038,422 on net sales of approximately $108½ million. Earnings the previous fiscal year, in comparison, were $4½ million net on sales of $80 million.

The ten Dresser companies, which are builders and distributors of equipment used chiefly in the petroleum and natural gas industries, last year accounted for $79.5 million of the total net sales and $5.7 million of the company's net earnings, according to H. N. Mallon, president.

Tennessee Case Put Off

The FPC hearings on the "lawfulness" of rate schedule revisions proposed by Tennessee Gas Transmission Co. have been postponed until March 15. The postponement was made on motion by Tennessee and three customer companies which had objected to the proposed changes. The three are Hope Natural Gas Co., East Tennessee Natural Gas Co., and Tennessee Natural Gas Lines Inc.

The commission had already suspended the changes, which would change the quality provisions so that quality would be determined at the temperatures and pressures in Tennessee's lines, and would—in effect—put specific volumetric ceilings on the company's obligations to supply its entire requriement customers.

Safety Issue

A special issue of *GAS* — devoted to safety in the gas industry — will be distributed in July. This big issue (more than 200 pages) will cover operations in every phase of the gas utility and appliance industries. Every conceivable hazard will be considered, and a graphic presentation of safe and correct practices will be made.

Regular readers are already on the mailing list for the special safety issue. Those desiring extra copies for distribution to employees, dealers, local legislative authorities, or others concerned with the vital subject of safety may order such copies from Jenkins Publications, 198 S. Alvarado, Los Angeles. Price of the safety issue will be $2, unless ordered in advance of publication—in which case the special price of $1 will be made.

Dump Truck and Bus for Workmen - - All in One

This "New Look" dump truck is owned by Natural Gas Co. of West Virginia and is used in its street repaving department. On a standard 1½-ton Chevrolet a hydraulic lift was installed (operating from a power take-off on the transmission) and a steel bed was constructed and attached.

On the steel bed a large tool box for long-handled shovels, picks, sledges, and concrete refinishing tools was built. A steel tubing framework makes this tool box a seat for workmen riding to a job.

Considerable shoveling has been eliminated by the device in dumping street surfacing materials: it can be raised to and locked at any angle. The bed cannot be either raised or lowered if the truck is underway.

GAS PRODUCTION

Alberta Gas

Royal commission hears export arguments

The three-man royal commission investigating the natural gas situation in the Canadian province of Alberta has been having a busy time. The proposed $100 million pipeline from Alberta to the Pacific Northwest region of the United States depends on the commission's recommendations.

The commission has listened to hundreds of thousands of words of testimony—here are some of the highlights:

1) Faison A. Dixon of New York, president of the Northwest Natural Gas Co. of Seattle (which proposes to construct the pipeline) said the company intends to sell its gas for about 40 cents per Mcf to distributors in Seattle.

2) W. C. Spooner, Shreveport, La., geologist representing the Northwest company, said his investigations indicated the province's proven gas reserves as of Dec. 1, 1948, were 4.9 trillion cu ft. He felt a reasonable expectation of new gas reserves during the next five years would be 3 trillion cu ft.

3) Hanina Zinder, Washington, D. C., formerly a member of the FPC, stressed that retention of a supply of natural gas for local consumers is a consideration before the FPC grants the right to export gas.

4) James Walker of Edmonton, Canadian manager for Northwest, said no pipeline would be built by the company if fields in

western Montana and Wyoming capable of supplying coast cities are opened before construction of an Alberta-to-Seattle line is started.

5) Dr. John F. Dodge, geologist for the Shell Oil Co. (which has a tentative contract to take gas from the Northwest company), said that about two-thirds of the reserves of the Jumping Pound section would supply the needs of the proposed pipeline to the Pacific Coast.

(Dr. G. S. Hume of Ottawa, Canadian government geologist, testified during the January sittings that the Jumping Pound field has an estimated reserve of 800 billion cu ft. Dr. Hume had told the commission he considered the Jumping Pound estimates "reasonably dependable.")

Mr. Dixon read a letter to the commission in which he made an offer to the Canadian Western Natural Gas Co. of Calgary and Northwest Utilities Ltd. of Edmonton to deliver additional natural gas to the two companies.

The letter said tentative contracts with California Standard, Imperial Oil Ltd., and Shell Oil Co. had been entered into for the supply of gas to Seattle, Portland, Vancouver, and Spokane and that further contracts with Canadian Gulf Oil Co., and McColl-Frontenac Oil Co., were being sought.

To meet the objection that export would reduce the province's reserves, the company was willing to enter into a contract for piping adequate supplies of gas for the cities of Calgary and Lethbridge, and for selling gas for Edmonton.

Mr. Dixon said $40 million would be spent in Canada in building the pipeline. Salaries in Alberta would amount to about $1 million a year while wages from supply producers would give Albertans another $250,000 a year. The cost for rights of way would be $500,000.

The New York executive outlined two schemes for the Alberta section of the 1700-mile pipeline. A U-shaped gathering system would enter Alberta near Pincher Creek, with one branch going north to tap Jumping Pound and a second larger branch circling out to include the Princess and Kinsella fields.

The other scheme, based on the possible opening by Imperial Oil of the Leduc oil field for gas, was a straight main line from Macleod to Leduc with branches to Pincher Creek, Jumping Pound and the Princess and Kinsella fields. The main line of the pipe would require 24-in piping from Seattle to Macleod, the rest 20- or 22-in pipe. A total of 250,000 tons of steel would be necessary and he thought this would become available by the end of the year.

Capacity of the line would be about 26 billion cu ft a year or 209 million a day at peak load capacity.

Mr. Dixon said that building of the proposed pipeline could make available propane gas for most of the farms in Alberta from Edmonton south to the U.S. border and could also help extend rural electrification.

(Imperial Oil has completed plans for a $6.5 million gas gathering system, compressor station and gasoline plant in the Leduc area. The plant will have a capacity of 24 MMcf per day, and will recover propane, butane, and natural gasoline. Work is scheduled to start this spring.)

Mr. Dixon mentioned, also, that his firm

had contracted to fuel the huge Consolidated Mining and Smelting Co. smelter at Trail, B.C., presently heated with coal from the Crowsnest Pass area straddling Alberta and British Columbia. It would mean a 20-mile branch line and take a load of 20 million cu ft of Alberta gas a day.

Mr. Spooner, in giving his estimate, said it was his opinion that the gas reserves in Alberta "are adequate for local consumption in Alberta and for export outside the province."

Mr. Spooner's figures differed from those of Dr. Hume in his consideration of Pincher Creek as a "proven but incompletely developed" field with a potential of 500 billion cu ft of gas reserve—on the strength of the one well opened there.

Dr. Dodge felt that construction of the pipeline would require about eight to ten wells on the structure, which he estimated at about 5700 acres in area. Other wells could be drilled to supply the needs of other consumers once this market to the United States had been opened.

Mr. Walker said the company agreed not to sell the exported gas as raw material for use as synthetic gasoline or for any process manufacturing liquid hydrocarbons. The company would pay a minimum of $172,864,000 for gas in the ground in Alberta during the first 25 years. The total royalties during that time would amount at 15% to $25,929,600, of which $9,700,000 would go to the province and the balance to private owners in Alberta.

Mr. Zinder said he assumed that the Federal commission would give preference to inter-state pipeline companies over foreign exports if it were shown that there was not an adequate supply for both.

* * *

Another aspect of the Canadian picture shows that exploration work now being undertaken to determine oil and gas possibilities in the Winnipeg, Manitoba, area may result in the abandonment of plans to construct a $49 million natural gas pipeline from Alberta oil fields to Winnipeg.

F. A. Dixon said he "doubted" that the Winnipeg line would ever be built. He gave as his reason, exploration now under way "in the vicinity of Winnipeg" for oil and gas.

Earlier the royal commission was given a detailed outline of the projected pipeline that would pipe natural gas from Alberta more than 700 miles eastward to Winnipeg.

Julian Garrett of Edmonton, former general manager of the Edmonton gas system, said at the present rate of 50 billion cu ft a year consumption in Alberta, 56 billion a year for the Seattle-Vancouver project, and 26 billion a year for his own project, the minimum reserves in Alberta would last 112 years. If export was restricted to the prairies, reserves would last for 195 years.

Happy Birthday

J. J. STAMM, treasurer of the A. O. Smith Corp., looks on as Herman Welzien, in his 58th year of service with the company, lights the candles on the 75th birthday cake of the corporation. The firm was founded in a basement in Milwaukee in 1874 by C. J. Smith and his sons, one of whom, Arthur O. Smith, produced the first pressed steel auto frame in 1902, the company taking his name in 1904.

Battles in Texas

The issues of flaring, unitization of oil and gas fields, and "export" taxes on natural gas are causing a lot of commotion in the Texas natural gas industry.

The Flour Bluff field flaring case has been put on the docket of the Austin court of civil appeals for May 4—by which time operators expect to have all gas wastage stopped. Houston Natural is scheduled to begin taking all residue gas from the Flour Bluff gasoline plant May 1. The Fullerton field case was postponed from its original date to late February, with operators there also certain that flaring would soon be halted. Final disposition of both these cases depends in a large part on the Texas supreme court decision on the Heyser field case. The high court, meanwhile, took no action on the state's appeal of a permanent injunction against the Texas Railroad Commission's order to shut down Heyser field.

Nine oil fields have been exempt by the commission from the January general shutdown order. The fields were said to be conducting secondary recovery programs, repressuring projects, or producing large amounts of salt water. Chairman Murray, of the railroad commission, had a kind word for the oil industry last month, saying, "I am not excusing the wastage of gas nor excusing the delay which has taken place in effecting a conservation program, but I believe any fair appraisal . . . will show bright spots as well as . . black spots. I think that a really amazing program of conservation has been inaugurated since the war and is probably being carried out as rapidly as the material situation permits."

A unitization bill which authorizes voluntary oil and gas unitization agreements was introduced to the state legislature by George Moffett, Texas state senator. It calls for authorization of agreements for cooperative development and operation of all or any part of an oil or gas field by two or more operators. A bill from Sen. Wardlaw Lane gives guar-

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Panelair operates on new principle. Twin, 2-speed fans deliver steady flow of warm air, at *floor level* . . . end cold floor discomforts . . . give that feeling of all-over warmth that is the basis of real comfort. Panelair can be hidden in a wall. Operation fully automatic.

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Mail coupon for *free* plan book showing how Panelair is adaptable to virtually any floor plan.

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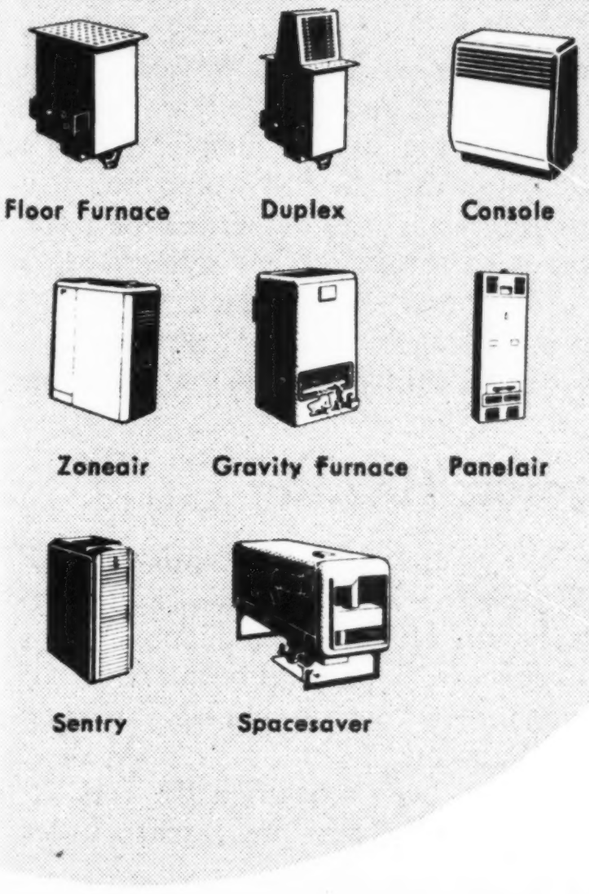

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dians, executors and the state the right to enter into oil pooling agreements; this bill resembles one part of Mr. Moffett's measure. Bills similar to Mr. Moffett's have failed in the last two legislatures.

And Representatives Tufares and McLellan got into the gas act with bills which would place taxes on natural gas. Mr. Tufares wants the state to tax at the rate of 1½ cents per Mcf at the well. He'd take the $42 million the measure would raise and put it into rural schools, rural roads, and state hospitals. Mr. McLellan's tentative figure is 1 cent per Mcf, the money going to rural roads; he will oppose raising taxes for any other purpose.

Synthesis Gas Process

Dr. Alfred Clark, of Phillips Petroleum, has invented a process whereby synthesis gas can be produced using as reactants methane, carbon dioxide, steam and oil shale. According to the patent, his process calls for charging oil shale and oxygen, or a gas containing free oxygen, to the top of a reaction chamber operated at elevated temperatures.

At the bottom of the reactor, stripped shale is removed, and a gas mixture consisting of methane, carbon dioxide, and/or steam is introduced. From an intermediate point in the reactor, gas containing hydrogen and carbon monoxide in proportion suitable for use in the Fischer-Tropsch type synthesis is withdrawn.

In the upper section of the chamber, the exothermic reaction between organic matter liberated from the shale and oxygen heats the shale and produces carbon monoxide and hydrogen; and in the lower section heat for the endothermic reaction of methane with steam and/or carbon dioxide to form hyrdogen and carbon monoxide is furnished by the heat carried by the shale from the upper exothermic reaction zone into the lower endothermic reaction zone.

Racine Preps for Natural

Wisconsin Gas & Electric Co., Racine, has started to supply propane-air in certain sections of its lines in preparation for the advent of natural, due in 1950. The company, a subsidiary of Wisconsin Electric Power Co., is making the changeover because of this availability and two other major factors: the limited capacity of the manufacturing plant at Racine and the inadvisability of enlarging it just prior to obtaining natural, and the limited carrying capacity of lines between Racine, Waukesha, and westward to other localities served by the company.

Cost of the changeover, including new plants at Waukesha, Watertown, and Fort Atkinson (all are west of Racine), and the expense of appliance adjustment, is estimated at $423,000.

Kansas Has Big Year

Kansas experienced one of its biggest years in oil and gas development in 1948. Two new gas fields were opened; out of 3065 new wells, 365 turned out to be gas producers.

The Kansas corporation commission set production value in oil and gas for the year in excess of $300 million.

REGULATION

PG&E Line

AEC and Colorado protest new line

Hearings on the 1600-mile Pacific Gas & Electric-El Paso Natural line, to bring gas from the Permian and San Juan basins to the San Francisco area (see *GAS*, Feb., p. 64), began in San Francisco in early February. PG&E advised the FPC that the line would be in operation before Jan. 1, 1951, if construction is permitted.

The California Public Utilities Commission has granted a certificate of public convenience and necessity for the line's construction.

If the FPC okays the line—further hearings are to be heard in the East shortly—work will begin this summer. When finished, the line will deliver to PG&E about 150 MMcf in 1951, 300 MMcf in 1952, and 400 MMcf in the next two years, wtih further increases possible. The present average load in the area now served by PG&E is less than 600 MMcf.

Strong opposition to the pipeline was taken at the San Francisco hearings by representatives of the Atomic Energy Commission and the State of Colorado. The AEC said it was acting to protect sources of natural gas close to its Los Alamos and Sandia projects, while the Colorado representative based his exception on the fact that gas in New Mexico fields partly underlies Colorado. It was pointed out as rebuttal to the Colorado intervenor's testimony against exporting gas that Colorado imports from Texas and Kansas.

Scrap Drive

Industry is being asked to make available heavy iron and steel scrap in order to maintain full steel and foundry production.

The secretary of commerce, Charles Sawyer, says, "We are seeking to stimulate operating executives to canvass their plants so that obsolete machinery, tools, and fixtures will be collected for use as scrap." The drive is aimed at getting scrap into normal channels of trade—to the scrap dealers who are equipped to prepare and ship it.

Heavy scrap is now in short supply, says the department, and scrap last year comprised more than half of every article made of iron and steel. Advantages to industry cited by the secretary (besides money obtained from the scrap and increased steel production) are that a proper cleanup campaign will clear valuable floor space and eliminate inventory costs on unused equipment.

DURING MARCH the Red Cross will ask for $60 million to continue the services the group performs in disaster preparedness and relief, for our military forces and veterans, and for health and educational services.

The AEC's representative admitted that the gas it was desirous of protecting would be used principally by the AEC's employees for domestic purposes, and not in the manufacture of the commission's end-product.

FPC Scans Rates

An FPC hearing on rates charged by the United Natural Gas Co., Oil City, Pa., began March 1 in Washington. Investigation of United's rates started after the New York public service commission had received application for a rate increase from Iroquois Gas Corp., Buffalo, which receives a majority of its gas from United, and asked the FPC to fix just rates for the gas supplied Iroquois. United and Iroquois are affiliates.

Municipal Bond Issue

A bill authorizing cities to issue revenue bonds to build natural gas transmission and distribution systems has received an okay from the judiciary committee of the Arkansas state senate.

Amendments to the bill provide that any bond issue called under the bill would be submitted to a vote of the people of the city involved, and that the bill would not disturb any existing franchises or permit the duplication of existing natural gas systems. Prominent utility men there argued that the bill would discourage investors from aiding privately owned utility expansions in Arkansas.

Hugoton Hearing

The oft-postponed FPC inquiry into Panhandle Eastern's stock and gas reserve transfer deal with Hugoton Production Co. (see *GAS*, February, p. 67) has been put off again, this time until a companion case now pending in the Supreme Court has been decided. Hearings had been scheduled for Feb. 7; the new date will be set "by further order of the FPC."

Camden Strike

Camden's mid-January strike was ended after 48 hours when government mediators negotiated an agreement between New Jersey workers and the Public Service Electric & Gas Co. for an immediate resumption of work with the wage dispute to be further arbitrated. The 100,000 domestic customers in the Camden area gave sighs of relief—there was just 12 hours supply of gas when the back-to-work order came—and industrial plants halted layoffs.

Technically, the strike was against the state government, as New Jersey had taken over the plants in 1947 to avert a strike and never returned them to private operation.

Pacific Lighting Champ

Largest gas system in the United States is now Pacific Lighting Corp., which passed Consolidated Edison in 1948. Meter count (that's independent, active meters in service) as of Dec. 31 of last year gave Pacific a score of 1,354,821 as compared to ConEd's mark of 1,342,832, which entitled the latter to second place.

Pacific Lighting owns Southern California and Southern Counties Gas Co.'s as well as its own operating system.

Good Safety Record

An enviable safety record was made in 1948 by the nearly 2600 employees working for the seven gas companies in the Pittsburgh Group of The Columbia Gas System Inc. The Group average frequency rate was 8.07 (this figure represents the number of lost time accidents per million man hours worked).

The National Safety Council reports that the frequency rate for all industry reporting to it was 13.26, with the gas industry as a whole reporting a rate of 22.05.

Another Pennsylvania company, Philadelphia Electric Co., went through 1948 without a single fatal accident. This is the third year in which the company has chalked up such a record, the other two being 1941 and 1944. Philadelphia Electric's last fatality was in November 1947.

Bundle for Britain

In 1940 the British government left a $20 deposit with the Laclede Gas Co. of St. Louis so the utility would turn on the gas in the royal pavilion at the Louisiana Purchase Exposition, and then, evidently, went off to meet Louie.

Anyway, His Majesty's emissaries forgot the 20 bucks. Did it get lost? Not with the Laclede Gas Co. at the controls. The company recently announced that whoever was qualified could pick up the money, and also stated that due to the benign machinations of compound interest the original deposit had become a tidy $259.70.

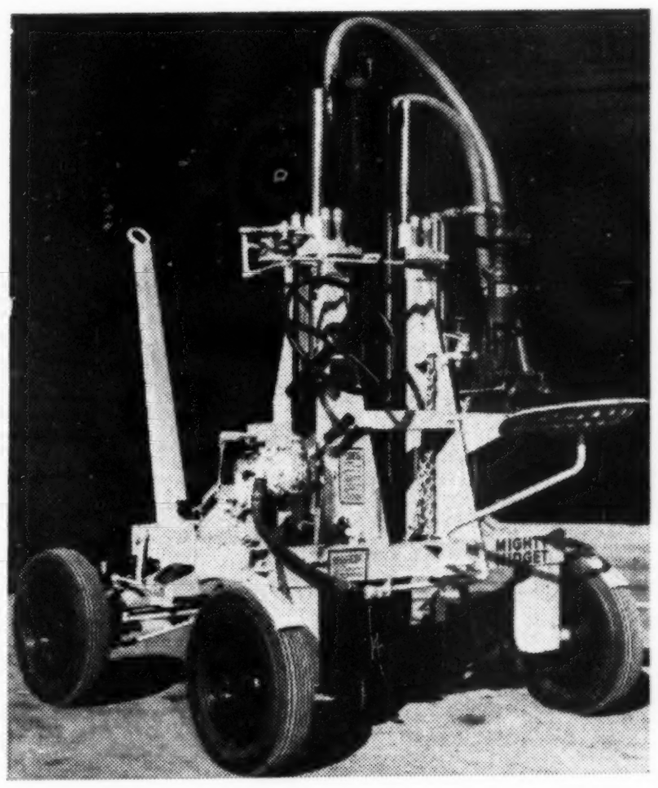
London papers please copy.

Pavement Breaker

RAPID PAVEMENT BREAKER CORP., 2751 E. 11th St., Los Angeles.

MODEL: Mighty Midget.

DESCRIPTION: New features now incorporated in this machine are said to make it easier to handle, and gains in yardage of concrete broken per day are claimed. All



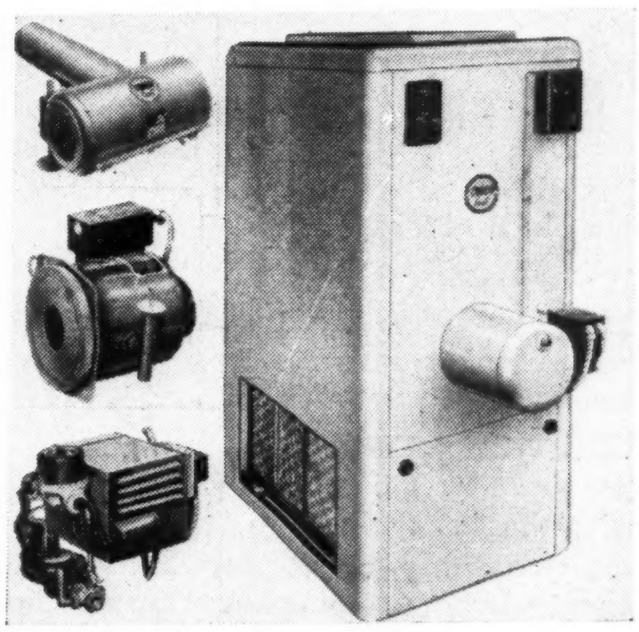
controls are within easy reach of the operator's seat, and he can see exactly where and how the hammer contacts the pavement at all times. A conventional steering wheel fits alongside the machine. Worm drive helps to hold the front wheel steady under difficult conditions, and new higher wheels allow the machine to run through broken concrete and remain on a straight course without sinking into the concrete.

Air Conditioner

CONCO ENGINEERING WORKS, Mendota, Ill.

MODELS: VF, TF, and GF.

APPLICATION: This is a triple-duty winter



air conditioner, easily adaptable to either oil or gas.

DESCRIPTION: Model VF is oil-fired with the Conco-Breese vaporizing type burner utilizing No. 1 fuel oil. Model TF, also oil-fired, is equipped with the Conco Magic Spray burner which makes use of No. 3 oil. Model GF features the Mono-Flame gas burner of the semi-luminous type.

The F series was designed to meet heating needs of families in all sections of the country. No structural changes in the unit are necessary to convert it from gas to oil or oil to gas. The substitution of one burner and control for another makes the change complete. The triple-duty air conditioner is a streamlined package, factory wired and assembled.

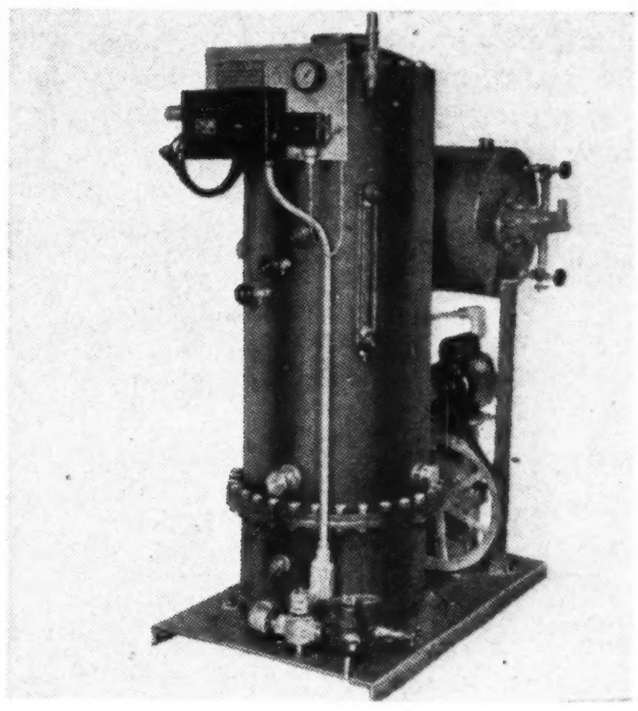
Steam Boiler

ALERT ENGINEERING PRODUCTS CO., 315 W. Woodbridge St., Detroit.

MODEL: Alert Automatic.

DESCRIPTION: The gas-fired automatic boiler is a packaged unit with trimmings, burner, controls, pump, and receiver permanently attached in proper positions and piped up with strainer, shutoff and check valves. The jet-type gas burner is suitable for natural, manufactured, or LP-Gas.

In case of fuel supply failure, an automatic control valve shuts off and must be reset



manually. A safety low water cutout is also included which shuts off the gas burner if the water level in the boiler becomes too low. The automatic boiler feed system maintains a uniform water level in the boiler by controlling the operation of the motor-driven, heavy duty feed pump.

The receiver tank is for both the condensate return and fresh water makeup. It contains a built-in float valve to admit fresh water as needed.

Metal Recording Chart

OTIS PRESSURE CONTROL INC., Box 7206, Dallas, Texas.

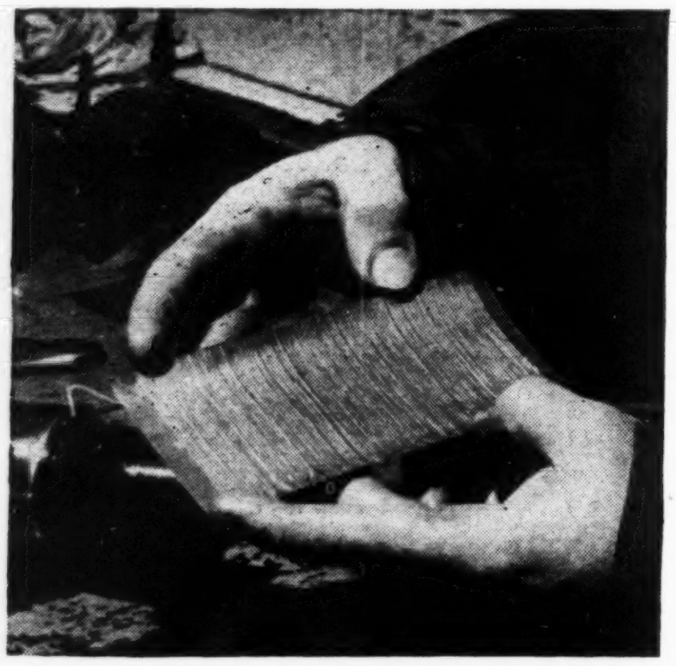
MODEL: Otis coated metal recording chart.

APPLICATION: For use in meters and recording instruments which are installed to operate under extreme temperature, pressure, and other adverse physical conditions.

DESCRIPTION: The manufacturer says this chart will not shrink, expand, deteriorate, or become deformed under atmospheric changes or by coming in contact with moisture, hydrocarbons, or corrosive elements. The patented coated surface will not crack, peel, or flake under these conditions. and it is sensi-

tive to very light stylus or dry pen pressure. Constant or erratic stylus movements can be recorded in a fine solid line, consistent in width.

The charts are being manufactured and used in thicknesses of .002 to .003 in. and can be made as thin as .001 to .0015 in. The chart material is available in blank face without measurement or division markings



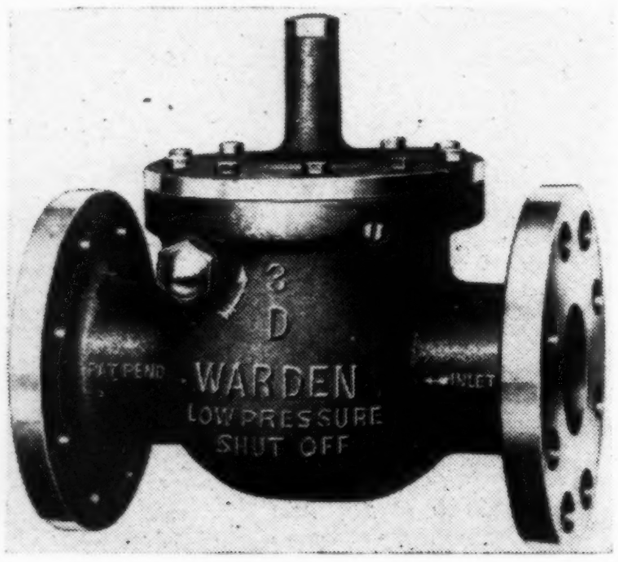
and can be trimmed to close tolerances and fitted flush into the working parts of an instrument or meter. Fluids, pressure, or atmosphere may be admitted into the working parts of the recording device since there is no need to protect the chart with a pressure or moisture proof seal. The chart is said to be suitable for photographic reproductions or photostatic blowups without retouching or processing.

Shutoff Valve

SECURITY VALVE CO., 410 San Fernando Road, Los Angeles, Calif.

MODEL: Warden automatic low pressure shutoff valve.

APPLICATION: For use on gas or fluid lines



where closure is desired when pressure fails from any cause.

DESCRIPTION: This valve incorporates a precision lapped synthetic rubber seat which provides for positive closure. The simple mechanical action is self-contained and is accurate and dependable, according to the manufacturer. Its mechanism is not dependent upon external actuating forces. An important feature is that the valve must be reset manually after closure. It is easily installed on gas or oil lines for industrial furnaces or public utility systems. Valves are set to close at pressure specified by the customer and are available in sizes from ¾ to 8-in. for both high and low pressure use.

Floor Furnace

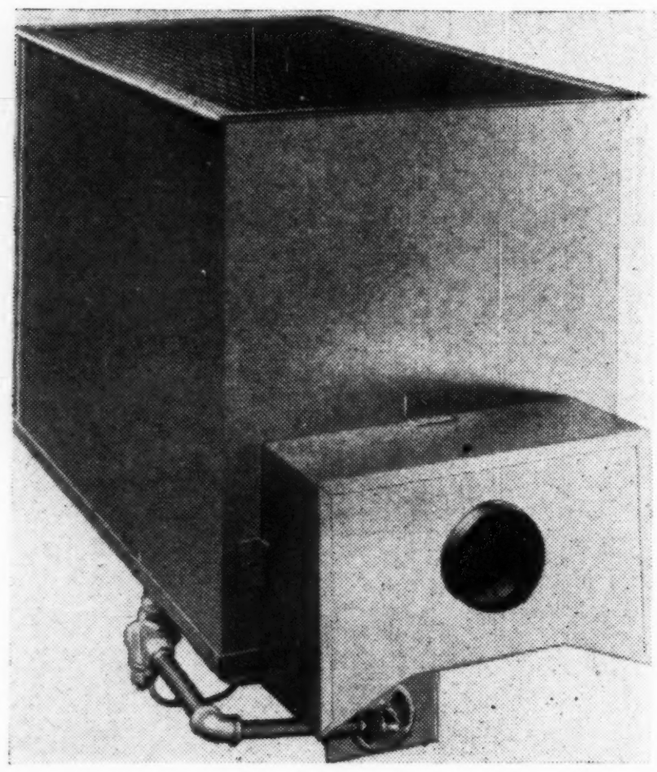
PERFECTION STOVE CO., Cleveland, Ohio.

MODEL: Superfex F-35, F-50 and F-65.

APPLICATION: For homes, churches, stores, schools, and other places of business.

DESCRIPTION: The Superfex gas floor furnace is a self-contained unit which fits directly below the floor between the studs, eliminating the need for pipes and ducts. It is approved by the AGA for natural, manufactured, and LP-Gas.

The control valve is accessible at the floor register for manual operation, but automatic operation is available if desired. The furnace comes equipped with a 100% shutoff automatic safety pilot control which shuts off gas to both main burner and pilot if the pilot light is accidentally extinguished. A draft diverter prevents the pilot or burner



from being extinguished by down drafts.

The heavy gauge combustion chamber and embossed radiators have been made gas-tight by continuous welding of all seams. A minimum excavation is required for the furnace, thus effecting a saving in installation costs.

The F-35 has a 35,000 Btu input per hour; the F-50, 50,000 Btu; the F-65, 65,000 Btu.

Firing Unit

ECLIPSE FUEL ENGINEERING CO., 730 S. Main St., Rockford, Ill.

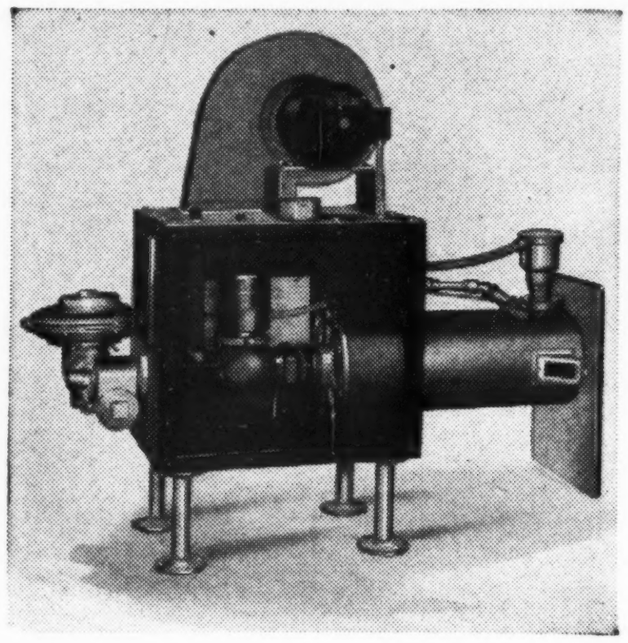
MODEL: Gas Pak.

APPLICATION: For the automatic, economical firing of many difference types of heating equipment.

DESCRIPTION: The package unit contains blower, burner, mixer, safety equipment, valves, regulator, piping and wiring. After gas and electric supply have been turned on, the unit is entirely automatic. Burner air and gas input ratio are easily adjusted, and the absence of excess air or gas helps reduce fuel cost.

Complete safety is provided by a built-in, electronic type flame failure unit. This closes the main solenoid valve instantly in event of pilot flame failure.

High efficiency is reported for the unit, due to precise control of the air-gas ratio and Btu input and the use of economical gas fuel.



Quiet operation results from the slow velocity of air draft and the use of a nozzle mixing type burner.

After Cooler

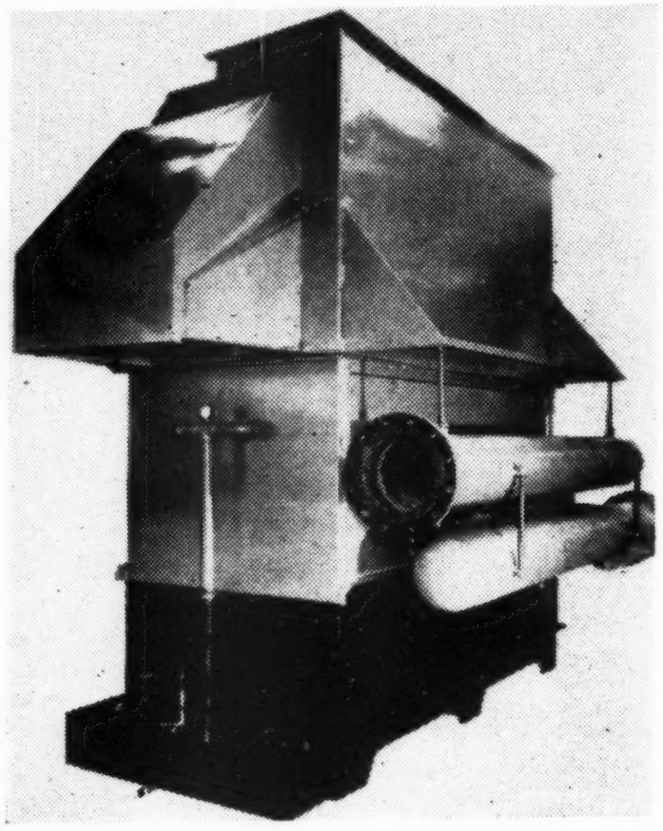
NIAGARA BLOWER CO., 405 Lexington Ave., New York 17, N. Y.

MODEL: Aero After Cooler.

APPLICATION: For dehydrating compressed air or gas.

DESCRIPTION: Protection against freezing in outdoor installations is insured by the "balanced-wet-bulb" control. A thermostat in the spray water reservoir is set for a desired low temperature limit at which it operates dampers to recirculate the air stream internally around a division plate in the center of the unit, instead of drawing in freezing air.

Dehydration is accomplished by cooling the



compressed air or gas to a temperature below the dry bulb temperature of the atmospheric air, thereby removing the moisture that condenses at that point and preventing further condensation of water in air or gas lines in use. This is done by evaporating a recirculating water spray on the surface of a coil through which the compressed air passes, creating a temperature close to the wet bulb temperature of the surrounding atmosphere and lower than the dry bulb temperature and also below the summer surface water temperature.

EMPIRE

is THE WORLD'S LARGEST MANUFACTURER OF GAS FLOOR FURNACES

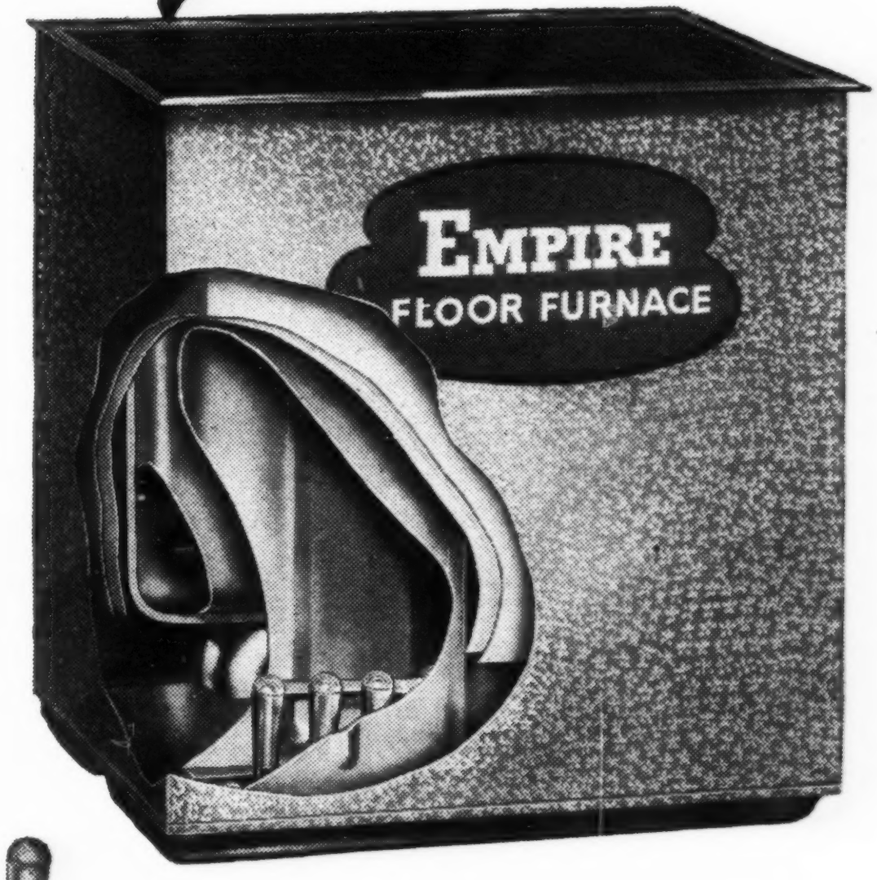
Because... EMPIRE Quality and Performance are Superior

AND PRICES LOWER!

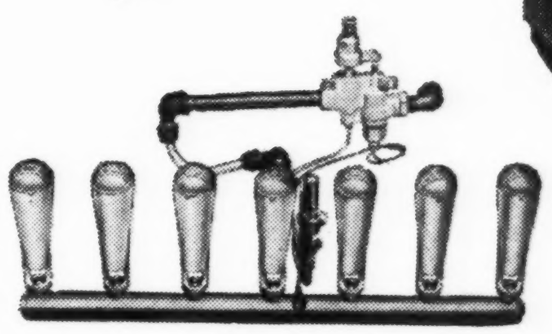
EMPIRE high achievement in engineering for gas has produced EMPIRE leadership in sales... the reward of superior quality and superior performance of EMPIRE Gas Heating Appliances. Mass production methods necessitated by nationwide customer preference, assure consistently lower prices for EMPIRE higher quality... and bigger profits for you.

THAN THOSE OF FLOOR FURNACES AND CIRCULATOR HEATERS OF INFERIOR QUALITY

The EMPIRE DELUXE *Gas* Floor Furnace



THE LINE WITH THE FAMOUS *Thriftmatic Gas*-BURNER



NOW! ALSO...

...THE EMPIRE Lo-BOY *Gas* FLOOR FURNACE... MEASURES BUT 24 INCHES FROM TOP TO BOTTOM

...SEE THE EMPIRE REPRESENTATIVE IN YOUR TERRITORY OR WRITE US DIRECT

EMPIRE STOVE CO. BELLEVILLE, ILLINOIS

MANUFACTURERS OF GAS HEATING AND COOKING APPLIANCES

SALES SLANTS

Gas Heater Forecast

A "five-year bonanza and capacity production in the gas heater field" are foreseen by A. W. Conley, president of The Coroaire Heater Corp.

As reviewed by Jack Cleary in the *Cleveland News,* Coroaire's sales in the first year of peace, 1946, were $8 million, then jumped to $14 million in 1947 before running into widespread utility restrictions on installation of new gas-consuming devices. As a result, sales in 1948 dropped to about $4 million.

As new supplies of natural gas become available, Mr. Conley sees a partial lifting of restrictions on installations of new gas-using facilities this year. By 1950, he predicts his firm will be doing a $20 million business, and if restrictions are fully removed by 1951 he believes sales will run $50 million.

"And because of lack of production during the war and restrictions on installations since," he continued, "I see a five-year bonanza and capacity production in the gas heater field."

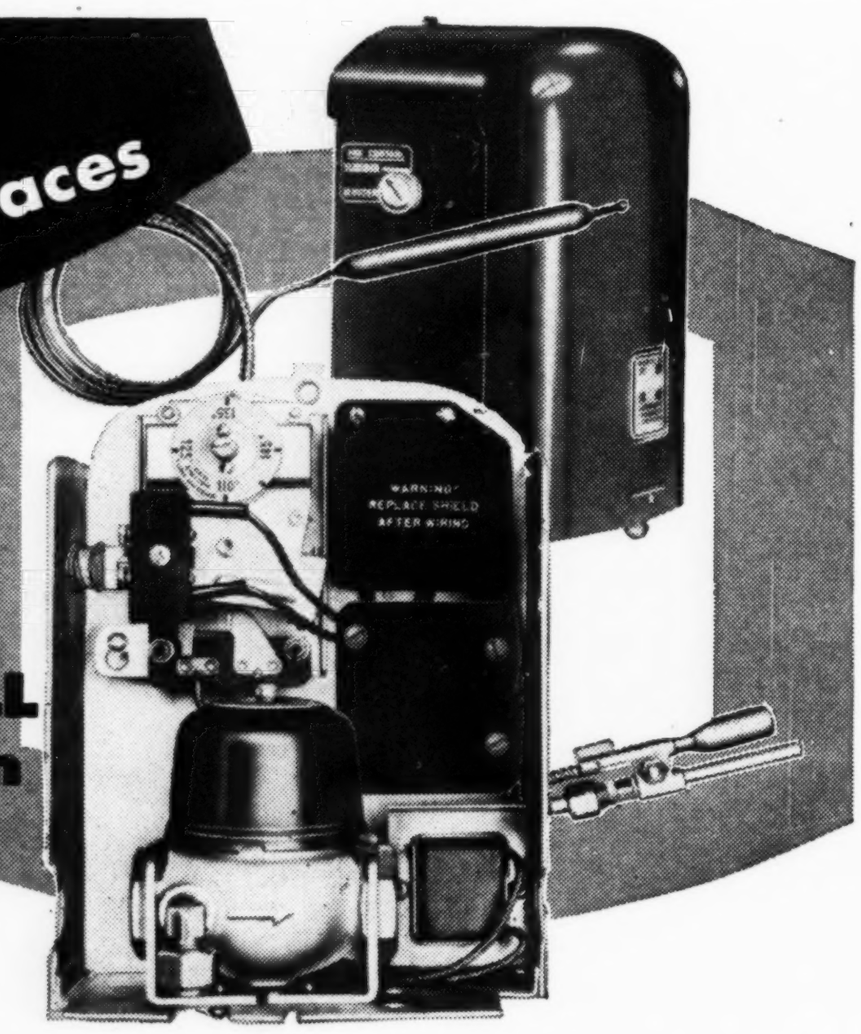
To get ready for the expected boom, Coroaire has added another divisional sales manager, doubled its field force and is planning further expansion to augment the company's 75 distributors and 20,000 dealers.

Three hundred thousand dollars has been budgeted for national advertising in trade publications this year, and distributors will spend another $500,000 for newspaper advertising.

Mr. Conley pointed out that the heater industry had not been affected by government regulations controlling installment credit, since heaters are not classed as luxuries but as necessities.

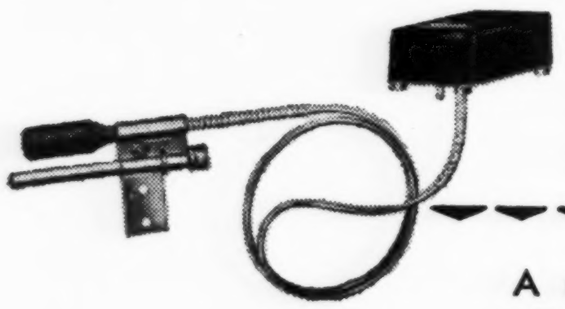
The heater business looks really set to go places.

New Production Savings for Gas Furnaces



Gas UNAPAC Provides for ALL Control needs in ONE COMPACT STREAMLINED UNIT

● This "All-In-One" Gas Furnace Control unit includes: New "Non-Gumming" Model 162 Solenoid, Electric Automatic Pilot, Combination Fan Switch, and Limit Control and Summer-Winter Fan Switch, Built-In Transformer, Thermostat Wiring and Complete Terminal Board. It affords production savings by simplifying assembly and installation — only *one* complete unit to install — no intricate wiring or piping. Costs less than separate controls and materials. Improves furnace efficiency, appearance, and operating satisfaction.



New "Fail-Safe" Electric Automatic Pilot

A new UNAPAC feature that offers positive "Fail-Safe" protection on natural or manufactured gas; shuts off gas if pilot flame goes out; has no moving parts in heated zone; requires no "button-pushing" for relighting.

Add A-P DEPENDABLE Gas Controls to YOUR Appliances. Write for complete A-P Gas Control Catalog.

PROTECTED GAS CONTROLS PERFORMANCE

AUTOMATIC PRODUCTS COMPANY

2526 North Thirty-Second Street • Milwaukee 10, Wisconsin

DEPENDABLE

CONTROLS FOR HEATING . . .
AIR CONDITIONING . . . REFRIGERATION

THE FIRST GOLD TAG in the national Court of Flame gas water heater sales campaign was earned by Joseph Miners, Newark, N. J., plumber who has been in the business for 45 years. Mr. Miners is shown with Edith Frey, GAMA, coordinator of the program. The sale automatically entered Mr. Miners in the contest and credited him with 100 prize units toward the quarterly and national prizes.

SALESMEN IN Brooklyn Union Gas Co.'s industrial sales section, new business department, are competing for prizes during 1949 in an effort to maintain or increase the company's industrial business. Six contests, each divided into half-year periods, have been set up. The separate contests will embrace the following:

1. Best performance in increasing load on all types of industrial business.
2. Greatest number of new industrial accounts.
3. Greatest number of automatic gas-fired steam boilers.
4. Most boiler horsepower.
5. Greatest number of sales, based on hourly input, to wholesale bakeries.
6. Largest single sale based on estimated annual new load to any industry other than bakeries and for equipment other than steam boilers.

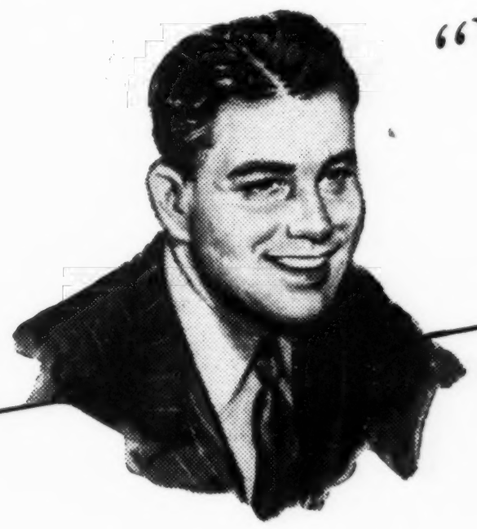
ANSUL CHEMICAL CO., Marinette, Wis., has expanded its sales network by opening a new district office in Knoxville, Tenn. Joseph F. Ziemann, 10-year veteran in the fire protection field, and Troverse F. Schmidt, former fire prevention engineer for Air Transport Command, will direct the work of the new office.

"Outstanding performance"

"Low-cost operation"

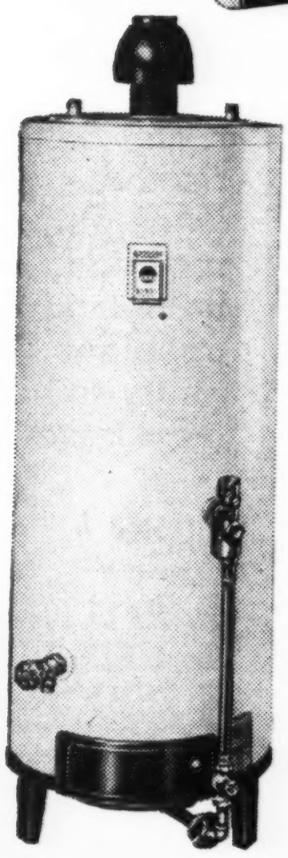
"Smart appearance"

"Years of service"



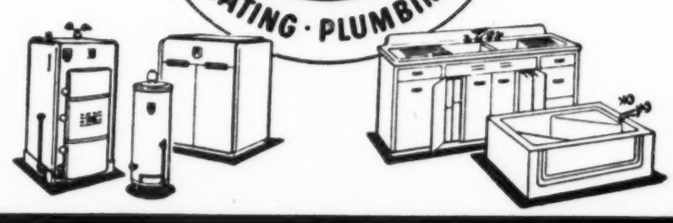
■ Such words of praise for good gas-fired heating equipment mean more and more popularity for gas as a fuel.

You get this valuable word of mouth advertising when you recommend American-Standard. For owners of boilers, furnaces and winter air conditioners from the famous American-Standard line are satisfied owners, who fully appreciate the efficiency and economy of gas heating. **American Radiator & Standard Sanitary Corporation,** P. O. Box 1226, Pittsburgh 30, Pennsylvania.



SENECA Winter Air Conditioner—Brings the healthful comfort of automatic gas fired winter air conditioning to small and medium sized homes. Burns manufactured, natural, mixed, or liquefied petroleum gas. Copper bearing steel heating element resists corrosion and rust. Extensive heating surface absorbs maximum heat from hot gases before they enter flue, assuring high efficiency and economy.

BUDGET Automatic Storage Water Heater —Provides a steady supply of hot water for every household need. Has gas-saving cast iron blue flame burner and safety controls. Center flue with spiral baffle insures quick recovery. Mineral wool insulation between heavy galvanized steel tank and trim jacket prevents heat loss and increases efficiency.



AMERICAN-Standard

First in heating . . . first in plumbing

Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILER • ROSS HEATER • TONAWANDA IRON

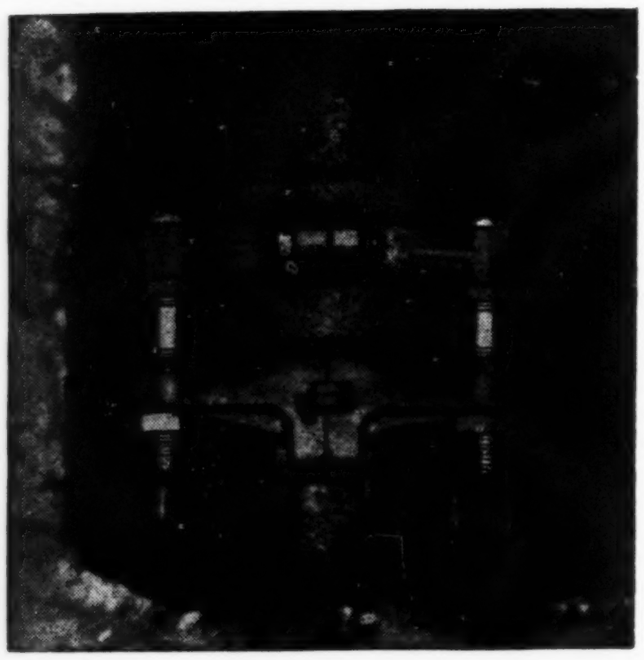
A SIMPLE SOLUTION for one of the GAS INDUSTRY'S *most trying problems*

the **NORMAC**

BELL JOINT CLAMP

SOLVES YOUR JOINT REPAIR PROBLEMS

6 inch Normac Clamp being lowered into hole for installation



6 inch Normac Clamp in service after installation

QUICK • EASY • PERMANENT

Installed in small pavement openings. Available in all standard sizes from 3" to 12". A simple set of tools cleans the joint, installs the clamp . . . often in only a quarter of an hour. SAVES TIME. SAVES MONEY and the repair is permanent. Designed for all conditions particularly where pavement repair costs are prohibitive. Such small opening repairs are scarcely noticeable when pavement is replaced.

Normac Clamps can be installed in large as well as small openings.

Norton - McMurray hold definite leadership in the development of methods for installation and rehabilitation work through small openings. We welcome the opportunity to help solve a problem you may have—tell us about it.

Write for our catalog describing our complete line of COUPLINGS . . . FITTINGS . . . SERVICE TEES and ELLS . . . SLEEVES . . . COMPRESSION-END COCKS . . . METER BARS and BRASS FITTINGS for copper pipe.

NORTON-McMURRAY MFG. CO.

39 SOUTH LA SALLE ST. • CHICAGO 3, ILL.

Method and product covered by U. S. Patents, Nos. 2,163,261 and 2,178,286.

THE FEBRUARY - March issue of *Living*, magazine for young homemakers, features an all-gas ranch-style house built by the magazine in Palos Verdes, Calif. The house will remain open for two months following its Jan. 30 bow to the public. In addition, it will be duplicated entirely or in part in seven stores across the country. Wholly gas-fired, the house is heated by means of air forced through ceiling grills in every room. Its gas furnace is closeted in the certified New Freedom gas kitchen, which also contains a gas range and gas refrigerator. Laundry equipment includes a gas-fired clothes dryer, and an automatic quick recovery gas water heater serves the home.

AMERICAN - STANDARD has prepared a new general mat service publication to help heating and plumbing contractors promote their products. The 40-page tabloid contains 100 complete advertisements in sizes from one to five columns in width. General information on proper methods of advertising, copy for radio announcements, direct mail aids, and suggestions on how to benefit from publicity are included. Dealers may obtain product illustrations, logotypes, and a variety of direct mail aids for use in designing their own ads. Copies of the general mat service publication may be obtained without charge from American-Standard wholesale distributors.

THE AGA Industrial and Commercial Gas Section has made a report on its 16-mm color-sound motion picture, "Where Food Is Finest." AGA has 15 copies of the film, designed for those interested in volume cooking, which are available on a loan basis. Four prints have been purchased by individual gas companies, and one copy has been given to the Canadian Gas Assn. for showings in Canada. Through Film Counselors, the organization which supervised production of "Where Food Is Finest," arrangements are being made to adapt the film to television.

ARTHUR R. PITMAN, recently resigned from the vice presidency of J. C. Pitman & Sons Sales Corp., has become president of a newly formed manufacturers' representative sales organization in Boston. Operating under the name of Arthur R. Pitman Sales Co., the new firm will represent the Anetsberger Bros. Inc. of Chicago and other manufacturers of food service equipment. William J. Marshall has been appointed sales manager of the new organization. His 14 years of experience include 10 years as sales manager of the "Frialator" equipment, which was invented by Mr. Pitman.

HAVING determined, through a survey, that the housewife's greatest cooking problem is "getting everything done at once," The Estate Stove Co., Hamilton, Ohio, is gearing its 1949 advertising to show how the Estate range will eliminate this problem. The spring series of ads will show, in four colors, complete meals centered around a ham. A smaller picture will point out where in the range each dish is prepared. The ads will also carry a coupon offering a free 32-page book entitled "Mealtime Magic."

CURRENT READING

FURNACE ATMOSPHERE REQUIREMENTS in the Ceramic Industry is the title of AGA Industrial and Commercial Gas Section Information Letter No. 26 prepared by the subcommittee on Ceramics under the chairmanship of Harvey C. Weller, Surface Combustion Corp., Toledo, Ohio. Excerpts from the letter follow:

It is the problem of the ceramic industry to comply with exact specifications for processes where quality standards of the product require atmospheric conditions during the firing of the ware, especially those conditions which affect the physical appearance and quality of the finished product. To be familiar with the constituents of the ware, the characteristic compositions, and its behavior during the firing process is very necessary.

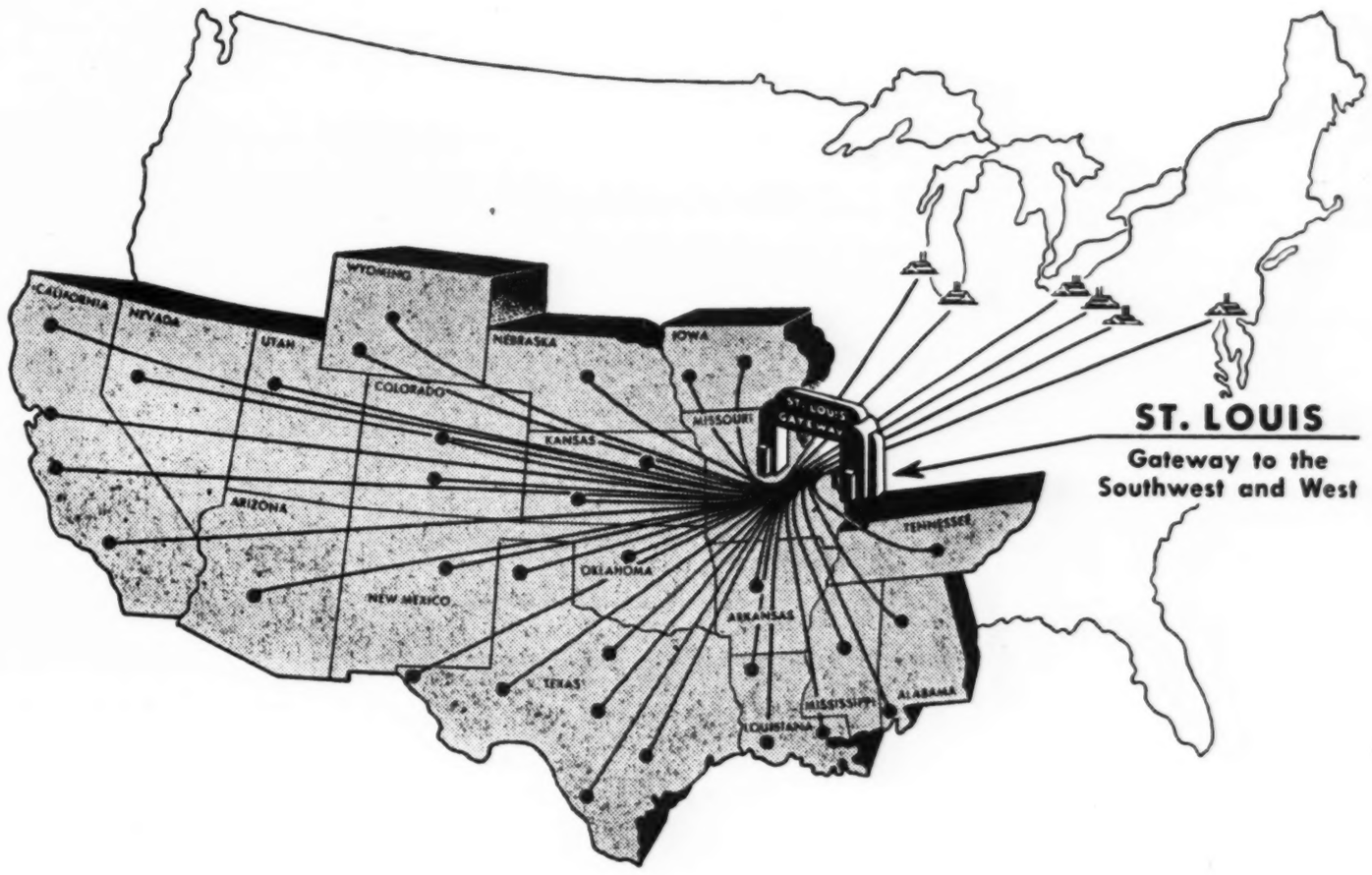
Poor gloss, blisters, and other surface difficulties on enameled ware are caused by deleterious gases in the furnace atmospheres during firing. The furnace design should provide for sufficient air changes in the burning zone to prevent any harmful concentration of gases in the furnace atmospheres.

GLOSSARY OF TERMS Commonly Used in the Manufactured and Mixed Gas Industries, prepared by F. H. Achard, consultant on personnel management problems, and Earl R. Hamilton, engineer, New England Power Service Co. The glossary is being distributed by Drahca Personnel and Training Services, 755 Boylston St., Boston. Price for single copy is 60 cents; 10 copies, 50 cents each; 25 copies, 40 cents; 100 or more, 30 cents. The book is designed primarily for non-technical employees of the manufactured and mixed gas industries and allied businesses. The definitions have been reviewed by laymen, a specialist in business English, a gas engineer, and a training specialist. Users will find terms defined in simple language which is technically accurate.

IT MUST BE SOMEWHERE!—A report on simplified records management prepared by Remington Rand Inc., New York, and presented in a sound motion picture in full color. The movie shows the vital importance of simplified, efficient filing methods in business. The film, complete with the services of an experienced operator and all necessary projection equipment, is available through any Remington Rand branch office for free showings. Running time is 28 minutes.

BRAZING is the title of the AGA Industrial and Commercial Gas Section's Information Letter No. 25. It has been submitted by the Ferrous Metals subcommittee to acquaint industrial gas engineers with brazing techniques in the use of manufactured and natural gas. The following paragraphs are from a portion of the letter titled "An Opportunity For Gas."

The industrial gas engineer, when confronted with a brazing problem, in competition with some other fuels, is now in a far more favorable position than he was formerly. Application techniques such as continuous furnaces brazing tables and salt baths have been developed in recent years for mass production of quality work at low cost and give gas a far more favorable position than



ST. LOUIS
Gateway to the Southwest and West

Coat Your Pipe at St. Louis

standard pipeprotection, inc. . . . offers minimum *through* freight rates with "in transit" storage facilities

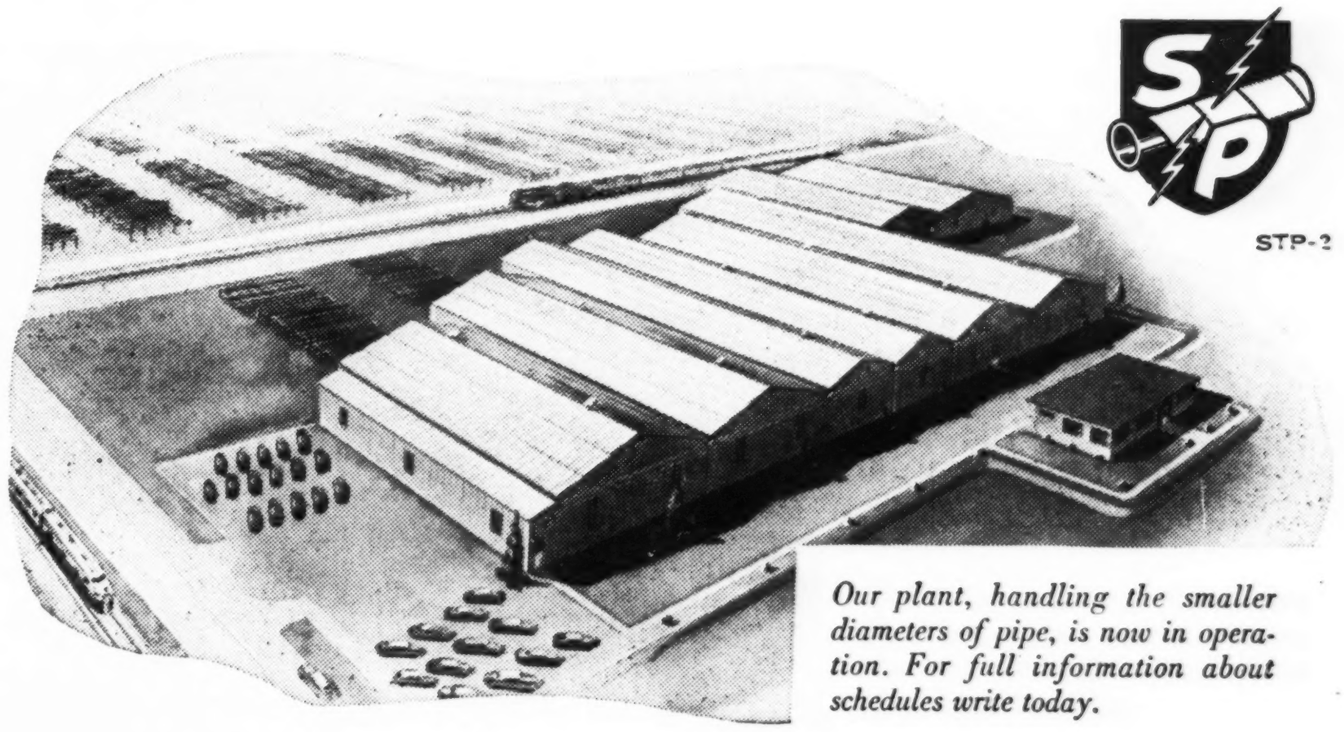
1 When you ship through the St. Louis gateway you use "through freight rates" instead of the higher combination rates generally used. This in-transit privilege permits stop-off for processing or storage up to 12 months at St. Louis without freight penalty.

2 Your pipe is cleaned, coated and wrapped to your own specifications by modern streamlined methods. Our plant and facilities (covering 22 acres) represent the last word in pipe handling equipment. The techniques used are the best practices that have been developed through experience by the industry.

From start to finish, the manufacturing process is controlled by standard procedures. This guarantees new standards of protection — new records in performance — important considerations these days to every buyer of pipe.

standard pipeprotection inc.

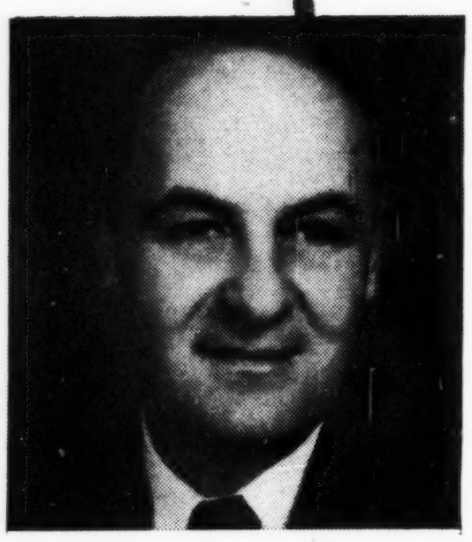
3000 SOUTH BRENTWOOD BOULEVARD...ST. LOUIS 17, MISSOURI



STP-2

Our plant, handling the smaller diameters of pipe, is now in operation. For full information about schedules write today.

"We estimate the overall cost in ditching will help to reduce construction expense of laying mains and service extensions."



Mr. S. V. O'Lenic, President, West Tennessee Gas Co., says this about the

Longhorn Mobile Ditcher

"We are very happy to highly recommend the use of this Ditcher and while we have used it for a very short period we are pleased with the performance to date, including the cost of operation.

"This unit, because of its size and mobility, can be taken direct from job to job within our distribution systems without the major problem of using a trailer. Therefore we estimate the overall cost in ditching will help to reduce construction expense of laying mains and service extensions."

LONGHORN MOBILE DITCHER

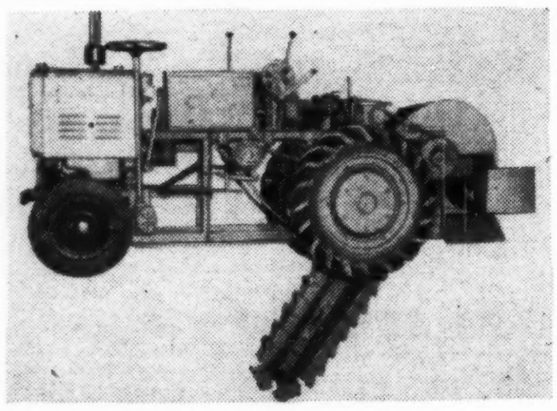
Has 90% of the features that distribution superintendents desire.

1—digs a 6" to 12" trench up to 42" deep, at a rate of 4 to 8 feet per minute; rated speed 1 to 25 feet per minute.

2—one-man operation.

3—travels on highways under its own power at 15 m.p.h.

4—43" tread squeezes into narrow places: can be spread to 63".



5—"hip" action allows operation of 30% lateral slope without undercutting.

6—weighs 5,000 lbs.

7—turning radius 12 feet.

WE WELCOME INQUIRIES . . *It will be a pleasure to send you complete information about the Longhorn Mobile Ditcher . . to answer your special questions. Let us hear from you.*

Longhorn Industries, Inc.

Henderson, Texas **Phone 1035**

it had attained previously. To realize these potentials in the use of gas for brazing requires an approach that is clearly defined by the circumstances.

Production brazing, as distinguished from job work, should be studied as a complete integrated process and all factors entering into the quality and production costs must be weighed if the best work is to be done at the lowest expense. Emphasis should be placed on the total cost per processed piece. This overall view, which insists that the choice of method be based on the cost per piece, calls for knowledge of brazing requirements and familiarity with accepted techniques. More particularly it calls for willingness to probe into the design of parts to determine if the existing design can be improved for better brazing results and in other cases whether designs can be profitably changed to permit the economical use of brazing in place of castings, forging or other operations. The acquiring of such knowledge is no small requirement and in many cases the industrial gas engineer should call in, for consultation, an expert in the brazing field.

The use of these new techniques in the application of gas will show that it can be adapted to an extremely broad range of work and give the customer quality mass production at a low energy cost.

NATURAL GAS INVESTIGATION, Docket No. G-580, is now available in printed form from the Supt. of Documents, Government Printing Office, Washington 25, D. C. Separate reports on the investigation were submitted to Congress last April by Federal Power Commission members Smith and Wimberly and Olds and Draper, and the two reports have been printed in separate volumes. Price of the Olds-Draper report is 40 cents, and of the Smith-Wimberly report, $1.50. A limited number of copies will be sent without charge to interested state and municipal bodies and other governmental agencies.

MEETING THE PEAK LOADS OF MANUFACTURED GAS, by E. S. Pettyjohn, director, Institute of Gas Technology, Chicago. This paper was contributed by the Process Industries and Fuels Division of The American Society of Mechanical Engineers for presentation at the society's annual meeting in New York, Nov. 28-Dec. 3. The 28-page paper includes a complete bibliography as well as a number of charts and tables.

1949 DIRECTORY OF OCCUPATIONAL SAFETY POSTERS, prepared by the National Safety Council, 20 N. Wacker Drive, Chicago. This 72-page directory contains 744 illustrations of two, three, and four-color posters classified under 15 sections. A convenient index helps locate posters on specific accident hazards. Posters may be reproduced if credit is given to the council. Price is 50 cents.

SOURCE BOOK OF PERSONNEL FORMS, by Lawrence Stessin and the staff of the National Foremen's Institute Inc. This book offers a convenient check list with which company forms may be compared and brought up to date. Illustrated and analyzed are 170 forms arranged under 33 topics. The 176 pages come in a multi-ring loose-leaf binder. Price is $7.50 f.o.b. Deep River, Conn.

Workshop Report

The following excerpts are from papers presented at the AGA Home Service Workshop held in Cleveland, Ohio, Jan. 24-27.

How To Build A Demonstration—Gladys Price, Southern California Gas Co., Los Angeles.

It seems that there is a definite analogy between building a house and building a demonstration. Both need blueprints, both need a builder, both need imagination and cooperation, and considerable investment.

Your boss' requirement to you in drawing up the blueprints for a promotional demonstration would be, first, that they produce sales. Too many home economists are imbued with the idea that if the customers are entertained or taught to make biscuits it is sufficient reason for the investment of huge sums of money by the utility in home service. It seems necessary very often to remind the builder of a demonstration that there must be some return of the buyer's money. The blueprint must be practical—no whipped cream and mushrooms in a demonstration for low budgets.

The specific range and refrigerator used in a demonstration should be definitely considered. Certainly some makes of appliances have advantages to housewives which others do not. Too often a general gas range discussion is given which loses sight of specific sales points of a particular make of range which, if they were exploited, would definitely appeal to a certain percentage of the audience. Good selling makes the most of even minor advantages.

To summarize the requirements of a blueprint for demonstrations, then, it must be: (1) sales slanted, (2) geared to the type of audience for whom it is given, and (3) mastered in every detail prior to presentation.

The selection of recipes to be used should be founded on what they will do for the appliances and not on some fancy job which looks pretty when it is finished . . . Each and every recipe chosen must justify its use in a sales slanted presentation.

Every part of a gas range or refrigerator is meant to be demonstrated. Select then those things which will bring out the superiority of the surface burners, the oven, and the broiler on the gas range; and the freezing compartment, storage space and other sales features of the Servel.

Regardless of the pattern, the sales promotion must be made to fit together so the audience gets a picture of ease, convenience, smoothness, and education all at the same time. Your audience should leave your demonstration so subtly sold that you have created the desire to purchase.

* * *

Home Service Community-Wise—Jeanne Montgomery, The Ohio Fuel Gas Co., Columbus.

Community activity is an invaluable part of our work in Columbus. This past year we have had many new and interesting experiences.

Battery of five R-C multi-stage, Centrifugal Gas Exhausters driven by steam turbines.

Standard Rotary Positive Blower, Type RCD, built in 8" to 22" gear diameters.

With a wide choice of Centrifugal and Rotary Positive Blowers available, you can usually select standard R-C units to meet your specific applications. Capacities range from 10 CFM to 50,000 CFM or higher for special requirements. Roots-Connersville is the only blower manufacturer offering you this *dual choice*.

We're impartial as to drives, too. We supply them or you can utilize drives already available. Direct motor, speed changer or V-belt, steam turbine, gas engine or other modern types provide high-efficiency operation for R-C units. That's another phase of R-C *dual-ability*.

With R-C equipment on the job, you'll enjoy long-time, trouble-free performance. That's because of sound design and sturdy construction, based on 95 years of building gas and air handling equipment, *exclusively*. For any such problem, consult R-C *dual-ability*.

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902 Alabama Avenue, Connersville, Indiana

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Newspaper activities were of major importance. One newspaper, with a circulation of 100,000, revised a tired-out, so-called "Recipe Contest." Four contests a year were held with our Home Service Dept. acting as judge. Grand prize was always a CP range secured through cooperation of the gas company or another dealer. About 3000 entries were received in each contest . . . Another newspaper held its 15th annual cooking school, its first since before the war. We assisted with this all-gas school which attracted 3300 women each day.

One radio station, a competitor of the station which carries our daily home service program, solicited our help in sponsoring a recipe contest. We judged the contest and appeared on the daily 15-min program to read our selections.

Our company has always regarded Red Cross activities as one of our best civic projects . . . The chairman of the service committee of a local grange had received permission to conduct nutrition projects in the grade school in her rural area. I referred the matter to our nutrition committee which set up and carried through the project . . . The local school board was so enthusiastic over the project that we were asked to repeat it in other schools under its jurisdiction.

When the women's groups of our Children's Hospital put on a large Christmas charity bazaar to raise money, one group used our kitchen to bake 400 dozen cookies for sale. We installed a range and refrigerator at the bazaar and for three days our home service girls baked cookies there.

Community activities must be wisely selected. We think ours were, for now when individuals and organizations in our territory have problems concerning food and equipment, they call first upon the gas company.

* * *

Platter Patterns—Harriette M. Lundberg, Michigan Consolidated Gas Co., Muskegon, Mich.

Highlighting our home service activity schedule each year is a program request from the foremost woman's club in the city . . . To tie in with their particular theme this year the women asked that we present something on "Platter Arrangements." Those of us who work with foods for display and photography are well aware of the importance of a definite platter design to show off well cooked food to best advantage.

We selected . . . from "Blueprints for Your Platter Meals" which ran in the February 1948 issue of *Better Homes and Gardens* . . . 12 sketches and worked them out in block design in color against a dark background, making charts which would display well in a large room. Each design was then illustrated with a large platter of prearranged food, which we displayed in our traveling mirror case.

We tried to select food arrangements that would allow the accompanying talk to emphasize such favorite topics as broiler meals, meals from the gas refrigerator, economy cookery, simple garnishes, and one-platter meal service.

* * *

Pink Teas For Teachers—Vanna Mershon, Oklahoma Natural Gas Co., Clinton, Okla.

One of the highlights of the school calendar is the annual affair given each fall by Oklahoma Natural Gas Co. for home economics teachers in our districts . . . Teachers are an important contact for us; that is why we go "all out" to present smorgasbords, brunches, teas, and dinners in unusual manners. Our something extra special this fall was a "Pink Tea."

We planned four menus around various unusual imported teas.

The teachers were guided through our newly remodeled ultra-modern department to view the very latest kitchens, equipment, and even office furniture and interior decoration.

After tea, the demonstration for the year was outlined briefly so teachers could set aside an early date for it. The 45-min demonstration this year is entitled "The Flame Family." A committee of our home service directors wrote it for CP gas ranges since our company this past year presented every home economics department on our lines a range or ranges built to these standards.

Such affairs as our "Pink Tea" are time-absorbing, but this year we've had a concrete example of how such things pay off. The school board in one of our large cities allocated money for new equipment for home economics departments. The teachers began flocking to us for information about ranges to purchase . . . The outcome was the purchasing of 35 gas ranges by the school board—and *we* do no merchandising.

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DIRECT WEIGHING
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Once calibrated and properly installed this Gravitometer requires no further attention. Hundreds are in daily use in pipelines and refineries of major companies. There are no electric motors, pressure regulating valves or other complex arrangements; is practically frictionless, thus minute changes in specific gravity are recorded as they occur. Years of use have proven that Arcco-Anubis Gas Gravitometers remain accurate and highly responsive even under severe conditions of service. Also, available in double column "dry air" type which automatically corrects for humidity content of the air. Send for bulletin No. 101.
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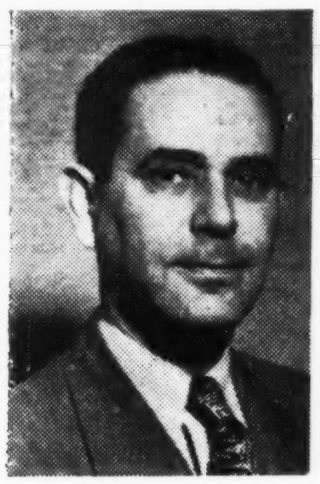
PEOPLE

HORACE MacVAUGH JR., division superintendent of Philadelphia Electric Co.'s eastern division, recently was named general superintendent of the utility's suburban divisions. Employed by Philadelphia Electric in 1926 as an engineering assistant, Mr. MacVaugh has served in almost all of the company's suburban divisions. He was superintendent of the western division from 1939 until 1942, and of the eastern division after 1942.

PAUL F. MARX has been appointed corrosion engineer for Dresser Manufacturing Division, Bradford, Pa. The company has instituted research on corrosion problems with particular emphasis on the protection of pipe joints. Mr. Marx has served in the corrosion engineering field with the Natural Gas Pipeline Co. of America, Northern Natural Gas Co., the U. S. Maritime Commission, and Williams Brothers Corp.

Henry Eddins
. . . Laclede



Paul Marx
. . . Dresser

HENRY A. EDDINS has been elected a vice president of The Laclede Gas Light Co., St. Louis. Mr. Eddins, a graduate of Texas A&M, was associated with the Stone & Webster Service Corp. from 1931 until he joined Laclede, except for military service. He became assistant to the president of Laclede on Jan. 1, 1948.

SYLVESTER M. HOFFMAN recently took over as safety director of Brooklyn Union Gas Co. As an employee of Utilities Mutual Insurance Co., Mr. Hoffman has inspected Brooklyn Union plants and facilities and attended company safety meetings since 1946. He has had experience as supervisor of safety programs for gas and electric utilities, railway and bus transportation companies, and coal mines.

H. W. Baird

HUGH W. BAIRD has been appointed vice president of Standard Pipeprotection Inc., St. Louis, Mo. Mr. Baird is widely known in the pipeline industry and has had experience in the production, sales, protection, and installation of pipe. The company was organized recently to coat and wrap pipe up to 12½-in. diameter, using new application techniques.

Smart dealers will maintain stocks geared to 1949's NEW Housing demand.

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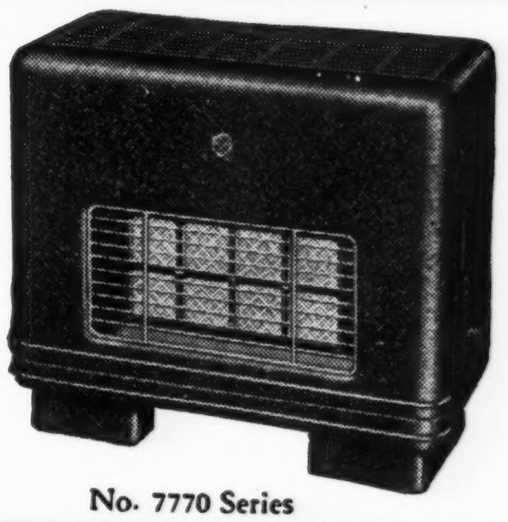

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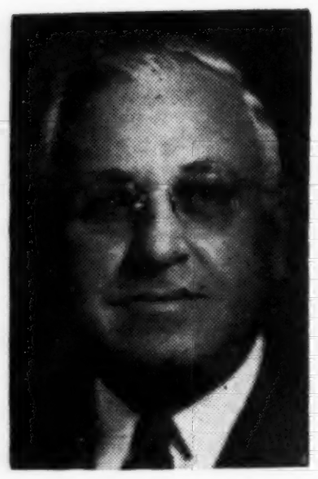
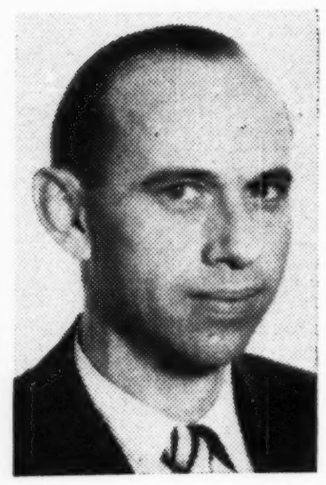
H. L. Spencer



E. J. Werthman

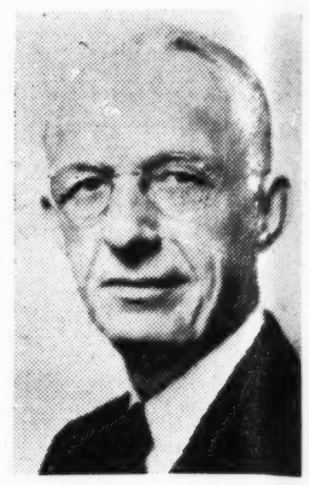
E. H. Roseberry

. . . Sprague Meter Co.



H. J. Evans

F. V. Snodgrass



L. M. Oaks

. . . Rockwell Mfg. Co.

F. L. FAIRCHILD, president, Sprague Meter Co., Bridgeport, Conn., has announced the election of ELMER J. WERTHMAN as vice president of the company. Mr. Werthman has served as manager of the Davenport, Iowa, branch for the past 20 years. Retiring vice president is E. H. ROSEBERRY of Los Angeles, who has held the post since 1939. H. LEE SPENCER has been apopinted western manager and is in charge of the Los Angeles branch of the company. For more than 10 years he has covered parts of the Pacific Coast and the Rocky Mountain states for the firm.

DR. HAROLD VAGTBORG, director of the Southwest Research Institute, has announced several appointments to the technical staff of the organization and its affiliates. DUFFER B. CRAWFORD, named gas research engineer, specializes in commercial production of gases. NORMAN C. PENFOLD was appointed assistant to the director. His special fields include internal combustion engine research and research on fuels and lubricants. A project leader for the Institute of Gas Technology, ERWIN R. STRONG JR. was named technician in fuels technology, and ION EDELEANU, specialist in hydrocarbon conversion processes and administration of invention assets, is the new consultant on inventions and licensing.

HERBERT C. ERHARD has been appointed sales manager of the Anderson (Ind.) Stove Co. The announcement was made by J. T. Mascuch, president of the Breeze Corporations Inc., Newark. Breeze recently took over complete control of the Anderson company. Mr. Erhard has been associated with the gas appliance business for 34 years, most recently as vice president in charge of sales for Standard Gas Equipment Corp., Baltimore.

FLOYD V. SNODGRASS recently was named general manager of the Nordstrom Valve Division's Oakland, Calif., plant by W. R. Rockwell Jr., president of Rockwell Manufacturing Co. New supervisor of gas utility sales for Pittsburgh Equitable Meter is L. M. OAKS, according to W. S. Andrews, manager of the Pittsburgh district office. HOWARD J. EVANS, previously in charge of general engineering of gas meter and regulator products for Pittsburgh Equitable, has been appointed chief engineer of Rockwell's DuBois division. Mr. Snodgrass has been associated with Rockwell or its subsidiaries since 1935, Mr. Oaks since 1931, and Mr. Evans since 1935.

LEONARD B. RICHARDS, president of The Harrisburg (Pa.) Gas Co., recently was elected a director of The United Gas Improvement Co. The Harrisburg company is a subsidiary of United.

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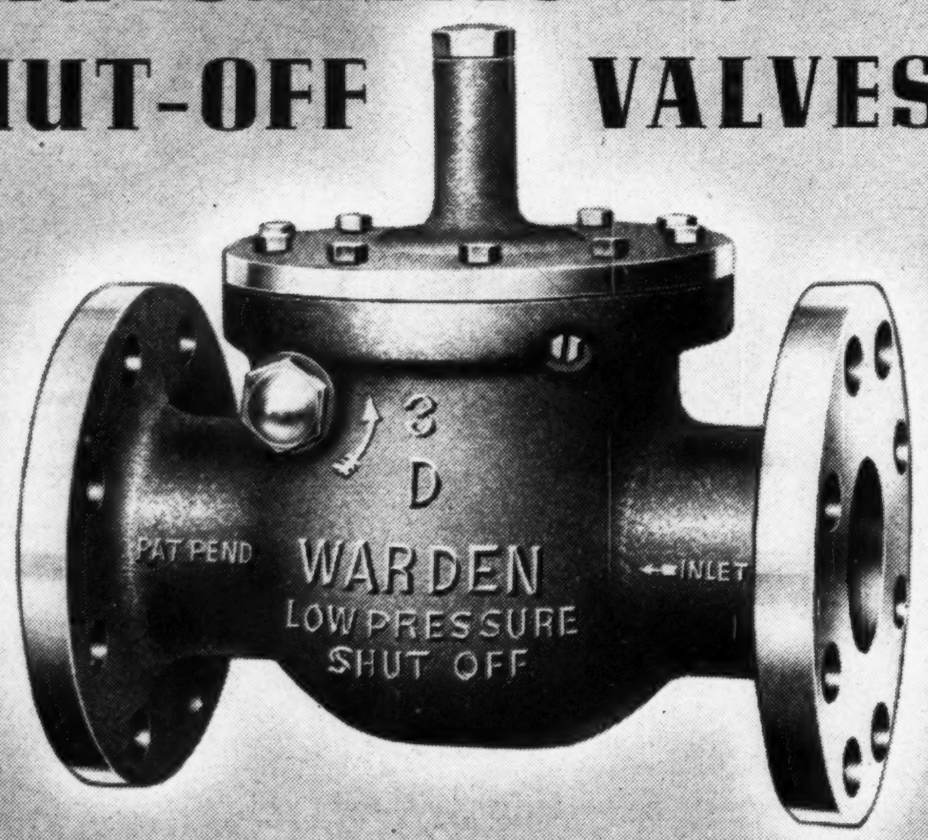
For Commercial and Industrial Users of Gas

•

For use on Gas Company Distribution Lines



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POSITIVE SHUT-OFF

FULL-FLOW DESIGN

Warden Shut-Off Valves provide absolute shut-off of fuel when the supply pressure fails *due to any cause.* The closure is positive. It will not leak or seep . . . will not re-open when the pressure returns . . . valve must be reset *manually* after the pressure is restored.

Manufactured by. **SECURITY VALVE COMPANY** *A California Corporation*

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CLYDE C. WHITCOMB, vice president of Kalamazoo (Mich.) Stove & Furnace Co., recently was appointed general manager of the firm, according to ARTHUR L. BLAKESLEE, president. J. J. HILMERT and H. C. HAWK have been named assistants to the general manager. DONALD J. DEVEREAUX, formerly with Florence Stove Co., has joined Kalamazoo as sales manager for metropolitan areas. He will make his headquarters in Chicago.

Thomas Evans

THOMAS H. EVANS has been appointed promotion manager, sales department, Equitable Gas Co., Pittsburgh. Mr. Evans joined the company in 1937 as a commercial heating salesman. He has served as commercial salesman, commercial representative, supervisor of commercial heating sales, and manager of commercial specialty sales. From December, 1942, until February, 1946, he was on military leave of absence. WALTER C. BOMHOFF has been appointed assistant manager of Equitable's planning and development department.

CECIL M. DUNN, recently appointed vice president in charge of sales of The Estate Stove Co., has been named general manager of the Estate Heatrola Division, Noma Electric Corp., Hamilton, Ohio. The announcement was made by JOHN A. SEUBERT who has announced his own retirement from his positions of executive vice president of Estate Stove and vice president and general manager of the manufacturing division.

SHIRLEY E. MESERVE, general counsel for the Fluor Corp. Ltd. since 1929 and its president since 1947, was elected chairman of the board at a recent directors meeting. Succeeding Mr. Meserve as president is DONALD W.

D. W. Darnell

J. S. Fluor Jr.

DARNELL, who joined the company in 1925 as an engineer. J. S. FLUOR JR., who was connected with the firm's management from 1921 to 1946, was elected executive vice president. W. EARL DUNN, executive vice president, is now vice president and general manager of the engineering and construction division, and J. ROBERT FLUOR, vice president and assistant general manager, is now vice president and general manager of the manufacturing division.

R. R. BLACKBURN, vice president and secretary of Southern California Gas Co., Los Angeles, has been elected to a two-year term as a member of the Los Angeles Merchants & Manufacturers Assn. board of directors. Mr. Blackburn has been associated with SoCal for 28 years.

V. L. BERGER and C. C. REDDING have been appointed district managers, Southwestern division, by Detroit-Michigan Stove Co. and will work under the direction of John M. Storm Jr., Southwestern divisional sales manager. In the Southeastern division, E. R. TILLOTSON is the new district manager. He will work with F. F. Hamilton, divisional sales manager. WARD JACOBSON is the Central division's new district manager, and Paul Inskeep is divisional sales manager.

HARRISON F. JOHNSON, vice president of Union Gas System Inc., Independence, Kan., for 10 years, has been elevated to the presidency of the company, succeeding the late Paul R. Johnson. Harrison Johnson, nephew of the late president, worked on construction of pipelines in the southwest for a number of years and joined Union Gas in 1936.

I. N. HAMILTON has been appointed by Caloric Stove Corp., Philadelphia, as district sales representative for Tennessee. Dealers in the state will be supplied from Caloric's Nashville warehouse.

WILLIAM R. McKNIGHT is Caloric Stove Corp.'s new sales representative in North Carolina and South Carolina. He is associated with L. H. Ernst, Caloric's southeastern division sales manager, at Winston-Salem, N. C.

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The growing requirements of regular customers and the needs of many new users of LPG, have expanded our production of Butane and Propane to over 40 plants in 8 states.

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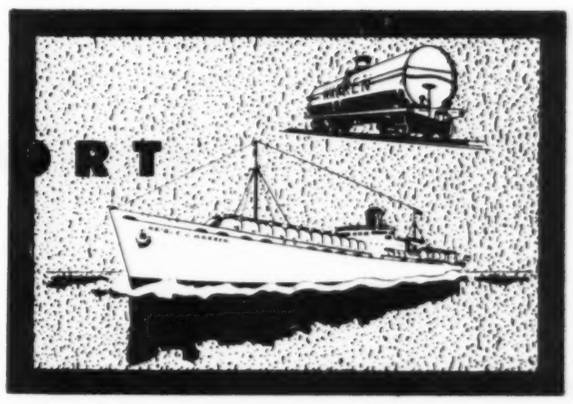
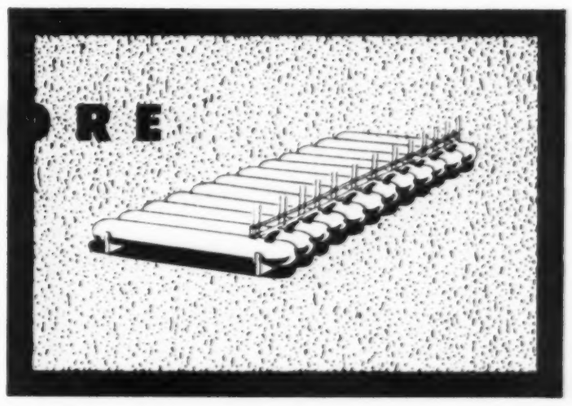


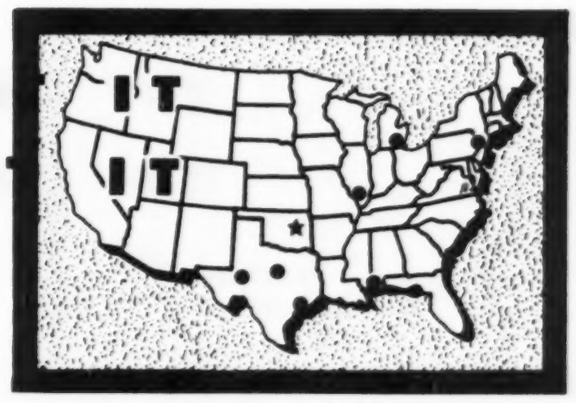
. . . AND STORE

Terminals at Newark, Houston, Texas City, Mobile, Little Rock, Des Moines and Cedar Rapids, with ample stock of LPG serve our regular customers and the many new ones who have turned to Warren.



THE LPG YOU NEED

WHERE YOU WANT IT
WHEN YOU WANT IT



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WARREN PETROLEUM CORPORATION

W. H. JONES, division superintendent of the Philadelphia Electric Co. at Morton, Pa., has been named purchasing agent for the utility. Mr. Jones joined the company as a junior engineer in 1926. Later he served as gas superintendent and electric superintendent at Morton, division superintendent at Coatesville, at Ardmore, and finally at Morton.

W. R. WIESCHENDORFF has been appointed district manager of the western offices of The Dearborn Chemical Co., Chicago. Mr. Wieschendorff will supervise the company's offices in Seattle, San Francisco, and Los Angeles. His headquarters will be in the latter city.

CARL A. TELLMAN has been elected president and managing director of the Montreal (Quebec) Gas & Coke Co. He joined the Canadian company, a Koppers Co. subsidiary, in 1928 at about the time of its organization. He has served successively as secretary and treasurer, sales manager, and vice president.

JOSEPH LEADER recently replaced the late Richmond Seabury as New England sales representative of The Welsbach Corp., Kitson Division, Philadelphia. Mr. Leader, of Chelsea, Mass., has long been identified with the plumbing and heating industry in New England.

MISS JANET NAUMAN, a recent graduate of Iowa State College in Ames, has joined the staff of Servel's Homemaker's Institute in Evansville, Ind. Miss Nauman holds a bachelor of science degree from Iowa State in household equipment.

C. D. ALLISON, general sales manager of Dearborn Stove Co., Dallas, has been named assistant general manager of the company. Mr. Allison will act as assistant to R. H. Norris, vice president and general manager of the company, and will direct the functions of sales, advertising and sales promotion, credit, accounting, parts and service, regional operations, and production.

MIFFLIN F. ARMSTRONG has been appointed Philadelphia district representative of The Estate Stove Co., Hamilton, Ohio. Mr. Armstrong was associated with Philadelphia Distributors for the past four years. He will assist in setting up Estate warehouses and service facilities in Philadelphia and Washington, D. C.

ALLEN BUTLER, vice president of the Perfex Corp., Milwaukee, has been named assistant to the president. V. P. BLACK, formerly manager of advertising, sales promotion, and sales training for Chrysler's Airtemp Division, has been appointed a vice president to fill the post left by Mr. Butler.

W. H. DREIER, K. H. WEYERBACHER, and W. G. KOCH have been elected directors of Southern Indiana Gas & Electric Co., Evansville. A. B. BROWN and C. K. GRAHAM have been named vice presidents of the company.

BERTRAND R. BERTRANDO, RAY E. COOLEY, CLYDE D. HINMAN, JOHN C. PACE, and WILLIAM T. TURNER are the five men beginning graduate work this term at the Institute of Gas Technology, Chicago. A number of fellowships are offered annually to selected college graduates who may take a two-year course leading to the Master's degree in gas technology or a four-year course leading to the degree of Doctor of Philosophy. This group will be joined in mid-term by PAUL A. FEDDE and SINESIO A. ZAGNOLI who are now completing their regular college work.

- OBITUARIES -

HAROLD E. DAVIDSON, customers department manager, Southern California Gas Co., Los Angeles, died of a heart attack on Feb. 7.

H. E. Davidson

Mr. Davidson's gas company career began in 1923 when he took a position as new business representative in Los Angeles. In 1927 he became sales supervisor and later served as supervisor of appliance sales and general supervisor of domestic sales. His transfer to the customers department came about in 1936 when he was made assistant general superintendent of that department. On Jan. 1, 1939, he became manager of the customers department.

JOHN C. BOLINGER, process design engineer for General Petroleum Corp., died Jan. 17 in Pasadena, Calif. Mr. Bolinger had been with the company since 1926. He contributed to the design of many of the distillation units at the firm's Torrance, Calif., refinery.

THEODORE CLAUSS, retired former secretary and treasurer of Cincinnati Gas & Electric Co., died Jan. 30 at the age of 79. Mr. Clauss joined the company in June 1881.

CATALOGS

WHEELCO INSTRUMENTS CO., 847 W. Harrison St., Chicago 7, Ill.—Bulletin T/C 7 is a new 40-page manual providing information on selection of proper thermocouples and protecting tubes, methods of checking thermocouples and pyrometers, and installation data. It lists current prices on thermocouples, thermocouple wire, lead wire, heads, connectors, plug and socket assemblies, insulators, protecting tubes, and radiation heads. Temperature-millivolt curves, resistance tables, pipe and wire sizes, and lead wire conduit capacity are furnished in chart form in a separate section of the book.

STATISTICAL ABSTRACT OF THE UNITED STATES FOR 1948, 69th annual edition. This 1064-page reference volume brings together the important summary statistics on population, trade, production, finance, and many other subjects. The source of each statistical table is shown and a 36-page index helps find the needed material. The book may be purchased from the Superintendent of Documents, Washington 25, D. C., or from U. S. Dept. of Commerce field service offices. Price is $2.75.

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Low Medium HIGH PRESSURE
SERVICE STOPS

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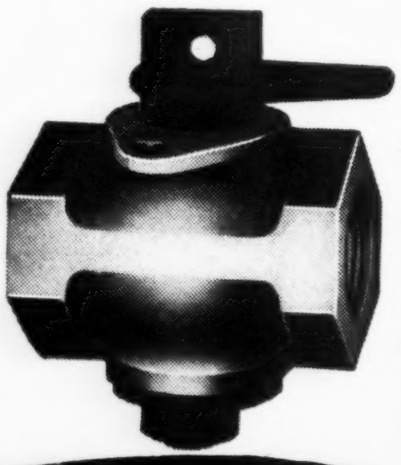

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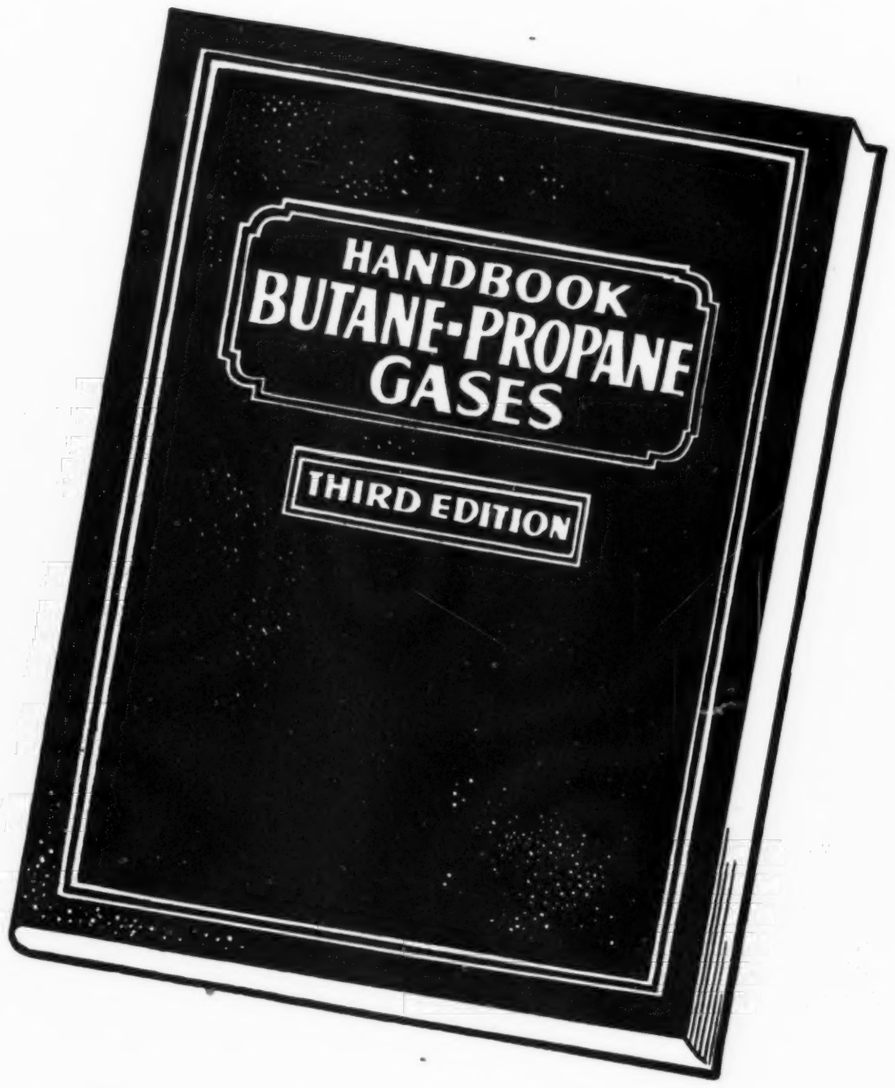

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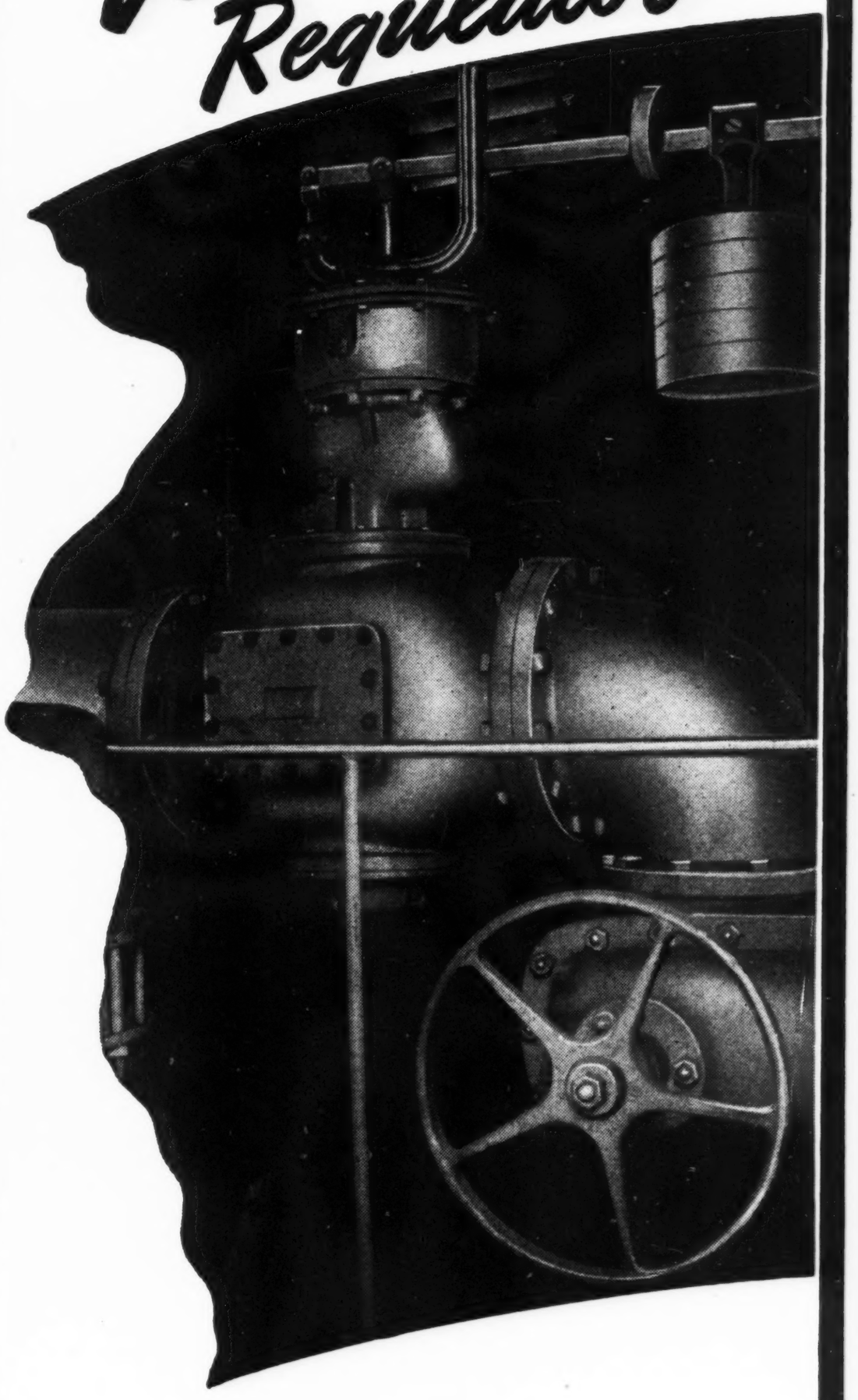

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TEMPIL CORP., 132 W. 22nd St., New York 11, N. Y.—Catalog No. 848, "Tempilstiks," is a revised brochure to provide more complete information on the use of Tempilstiks, Tempilaq, and Tempil Pellets for the accurate determination of industrial working temperatures. These products may be used to tell temperatures in welding, flame-cutting, tempering, forging, casting, molding, drawing, straightening and heat-treating according to the bulletin.

CLARK BROS. CO. INC., Olean, N. Y.—"Axial Flow Compressors" is the title of a new bulletin describing the compact, lightweight units which supplement the Clark line of reciprocating and centrifugal compressors. The units are suitable for electric, steam, or gas turbine drive. Customers may order the gas turbine drive compressor to specifications.

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LEEDS & NORTHRUP CO., 4934 Stenton Ave., Philadelphia—Catalog ND44(1) lists, for the first time in one publication, the company's complete line of strip-chart Micromax recorders and controllers for measuring a wide variety of process variables—temperature, speed, gas analysis, electrolytic conductivity, pH, etc. Titled "Micromax Model S—Indicating Recorders and Controllers," this bulletin gives complete specifications in tabular form. Suggested chart numbers are listed for the most commonly used ranges, together with other Model S accessories and supplies.

BRYANT HEATER CO., Industrial Division, 1020 London Road, Cleveland 10, Ohio—Bulletin 7C describes Pow-R-Assemblies, packaged industrial gas burner assemblies complete with pressure blowers. Capacities, specifications, dimensions, and alternative assemblies are described for the units, which are applicable to boilers, air heaters, dryers, kilns, ovens, and other equipment to which open burners with controlled flames are suitable. Size range is from 400,000 to 6.6 million Btu per hour output.

AGA TESTING LABORATORIES, 1032 E. 62nd St., Cleveland 3, Ohio—Supplemental Directory of Approved Gas Appliances and Listed Accessories. The appliances listed are those which were approved, listed, or added to the directory during the month of November 1948. This list supplements the Oct. 1 issue and is to be used in conjunction with it. It may be obtained from the laboratories at Cleveland or at 1425 Grande Vista Ave., Los Angeles 23, Calif.

TAYLOR INSTRUMENT COMPANIES, P. O. Box 110, Rochester, N. Y.—Bulletin 98170 is a revision of "Taylor Guide to Correct Instrument Selection." The entire industrial instrument line is presented, and the field of application of each type of instrument is covered as well as its principle of operation and range limits. Reference is made to catalogs available for anyone wishing more complete details about any type of instrument described.

HANDY & HARMAN, 82 Fulton St., New York 7, N. Y.—Bulletin 17 describes low-temperature silver alloy brazing with Easy-Flo or Sil-Fos. The catalog states that assemblies are strong, permanently leak-tight, and maintenance-free with this low cost process. The bulletin includes complete instructions for the brazing of fittings to both pipe and tubing.

WORTHINGTON PUMP & MACHINERY CORP., Harrison, N. J.—Two new catalogs have been issued. Bulletin W-350-B10 describes and illustrates Worthington mechanical seals for chemical pumps. Centrifugal pumps for belt, multi-v-drive, and motor drive are discussed in Bulletin W-305-B1A. Specifications, installations, ratings, and dimensions are covered.

THE HOTSTREAM HEATER CO., 2363 E. 69th St., Cleveland 4, Ohio—Illustrated Price Catalog No. 48 has been issued covering the firm's entire line of heaters. The 24-page bulletin includes detailed specifications and price information.